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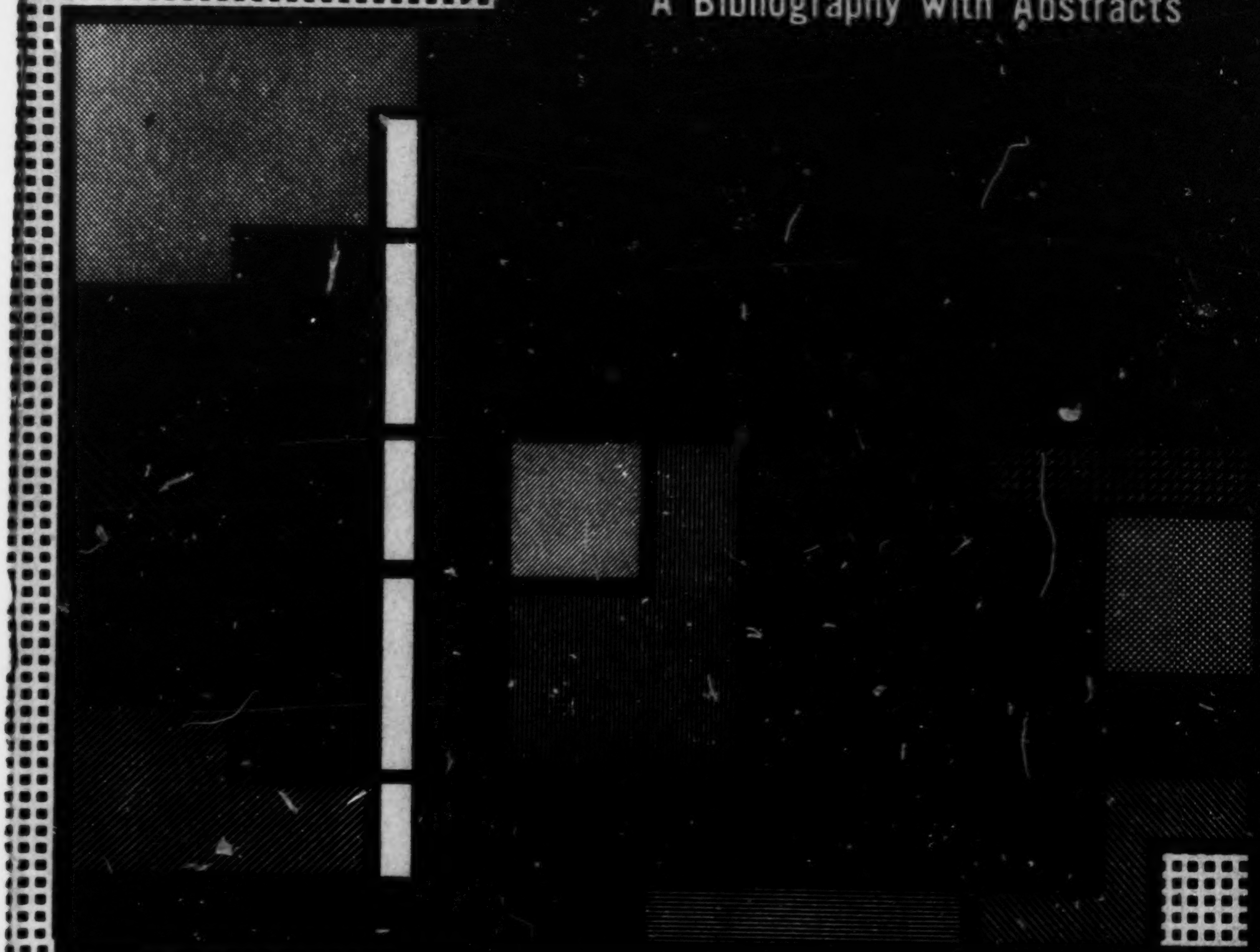
Air Pollution Aspects of Emission Sources:

ELECTRIC POWER PRODUCTION

A Bibliography with Abstracts



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AIR POLLUTION ASPECTS OF EMISSION SOURCES: ELECTRIC POWER PRODUCTION— A BIBLIOGRAPHY WITH ABSTRACTS

Office of Technical Information and Publications
Air Pollution Technical Information Center

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
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A compilation of approximately 1,040 abstracts concerning the contribution of electric power production to the air pollution level in the U.S. The abstracts are arranged in the following categories: Emission sources, control methods, measurement methods, Air quality measurements, Atmosheric interaction, Basic science and technology, Effects human-health, Effects-plants and livestock, Effects-materials, Economic effects, Standards and criteria, Legal and administrative, and Social aspects.

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CONTENTS

INTRODUCTION vii

BIBLIOGRAPHY

- A. Emission Sources 1
- B. Control Methods 51
- C. Measurement Methods 176
- D. Air Quality Measurements 191
- E. Atmospheric Interaction 200
- F. Basic Science and Technology 219
- G. Effects - Human Health 229
- H. Effects - Plants and Livestock 234
- I. Effects - Materials 237
- J. Effects - Economic 239
- K. Standards and Criteria 246
- L. Legal and Administrative 248
- M. Social Aspects 260
- N. General. 262

AUTHOR INDEX 267

SUBJECT INDEX 275

AIR POLLUTION ASPECTS OF EMISSION SOURCES: ELECTRIC POWER PRODUCTION— A BIBLIOGRAPHY WITH ABSTRACTS

INTRODUCTION

Electric power production contributes significantly to the overall air pollution level in the United States. To aid efforts to improve air quality, the Air Pollution Technical Information Center (APTIC) of the Office of Technical Information and Publications, Office of Air Programs has compiled this bibliography relevant to the problem and its solution.

Approximately 1,040 abstracts have been selectively screened from the contents of APTIC's information storage and retrieval system to cover the 14 categories set forth in the table of contents. The compilation is intended to be representative of available literature, and no claim is made to all-inclusiveness.

Subject and author indexes refer to the abstracts by category letter and APTIC accession number. Generally, higher accession numbers, representing the latest acquisitions, cover the most recent material.

All documents abstracted herein are currently on file at the Air Pollution Technical Information Center, Office of Air Programs, Environmental Protection Agency, P. O. Box 12055, Research Triangle Park, North Carolina 27709. Readers outside the Environmental Protection Agency may seek duplicates of documents directly from libraries, publishers, or authors.

A. EMISSION SOURCES

00532

W. S. Smith and C. W. Gruber

ATMOSPHERIC EMISSIONS FROM COAL COMBUSTION - AN INVENTORY GUIDE. Public Health Service, Cincinnati, Ohio, Division of Air Pollution. (999-AP-24.) Apr. 1966. 117 pp.

Information concerning atmospheric emissions arising from the combustion of coal was collected from the published literature and other sources. The data were abstracted, assembled, and converted to common units of expression to facilitate comparison and understanding. From these data, emission factors were established that can be applied to coal combustion processes to determine the magnitude of air pollutant emissions. Also discussed are the composition of coal, theory of coal combustion, emission rates, gaps in emission data, and future research needs. (Authors' abstract)

00691

J. M. Leavitt, S. B. Carpenter, and F. W. Thomas

AN INTERIM REPORT ON FULL-SCALE STUDY OF PLUME RISE AT LARGE ELECTRIC GENERATING STATIONS. Preprint. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-82.)

This paper presents an interim report on the current plume rise research project conducted by TVA under sponsorship of USPHS. The first two years of this 3-year study were completed in spring 1964 and were devoted primarily to field data collection. The third year will be used for data analysis and final report preparation. Plume rise data were collected at six coal-fired steam-electric generating stations within the TVA system. Unit ratings ranged from 112 to 650 megawatts with stack heights varying from 170 to 600 feet. Measurement of plume profile was made by three techniques--ground level photography, ground level modified transit readings, and helicopter observations. Meteorological measurements included wind direction and wind speed profiles by double-theodolite technique and vertical temperature profiles by helicopter. A description is given of the field instrumentation and data collection program and of a typical day's fieldwork. Typical data, including plume photographs, wind direction and wind speed profiles, vertical temperature gradient, and computer plume profile plots, are displayed. (Author abstract)

00943

F. Z. Rohrman and J. H. Ludwig

SOURCES OF SULFUR DIOXIDE POLLUTION. Chem. Eng. Prog., 61(9):59-63, Sept. 1965. (Presented at the 55th National Meeting, American Inst. of Chemical Engineers, Houston, Tex., Feb. 7-11, 1965.)

Authors discuss the sources of sulfur pollution and depict their results in charts (good analysis). The major areas covered are: coal combustion; coke; generation of electricity; refinery operations; ore smelters and roasters' sulfuric acid manufacture; refuse incineration; and coal refuse banks.

00972

M. Mayer

A COMPILATION OF AIR POLLUTANT EMISSION FACTORS FOR COMBUSTION PROCESSES, GASOLINE EVAPORATION, AND SELECTED INDUSTRIAL PROCESSES. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution, May 1965, 53 p.

The source emission factors presented in this report were compiled primarily for use in conducting an air pollutant emission inventory. The compilation is the result of an extensive literature survey and includes emission factors for the principal combustion and industrial processes. Obviously, the best emission factor to use for any specific source of air pollution is that resulting from source tests of the specific source. Unfortunately, many urban areas are not equipped to conduct the numerous and expensive stack testing studies needed for an emission inventory. The purpose of this compilation of emission factors is to provide the best available substitute to air pollution control agencies unable to conduct extensive source test programs. In certain cases, particularly in the combustion and refuse disposal areas, a single number is presented for the emission factor for a specific pollutant. It should be understood that the number is usually a weighted average of several different values found in the listed references. The compilation of source emission factors presented is, in our judgment, the most accurate currently available. As new technical advances are made, however, and additional emission data become available in the literature, the present compilation should be revised to reflect the newer data and developments.

01350

S.R. Craxford

AIR POLLUTION FROM POWER STATIONS. Smokeless Air (London), Vol. 36:123-128, 1965.

A large modern power station, for example, a station of 2,000 megawatts capacity, emits annually about the same amount of atmospheric pollutants-grit and dust, and sulphur dioxide-as an industrial city of a million inhabitants. The main problem of air pollution from power stations is to keep short-period maximum concentrations within tolerable limits. Grit and dust; and the natural dispersion of sulphur from high chimneys are considered.

01480

F. A. Rohrman, B. J. Steigerwald, and J. H. Ludwig

THE ROLE OF THE POWER PLANT IN SULFUR DIOXIDE EMISSIONS: 1940-2000. Preprint. 1966.

Even a severe realistic control effort will not be adequate to offset the rapid rise in potential source; sulfur dioxide emissions will increase to between 125 and 175 percent of the current level during the 1975 to 1990 period. Continuance of the degree of control being used today will result in SO2 emission of 58 million tons by 1990, over two times the present level. It is tempting to detract from the seriousness of these calculations by reassuring ourselves that these are national summaries and the growth in emission sources will take place outside existing metropolitan areas and will not greatly influence urban air quality. Since power plants become the overwhelming source of SO2 in the future (70 percent in 1975 and 76 percent in 1980) and since power generation facilities will continue to be located near the demand, i.e., people, it is probable that the increase in SO2 emissions will be even greater than the national average in selected regions of the country such as the East Coast megalopolis or the southern Great Lakes area. These, of course, are the areas of highest pollution levels at the present time.

01489

F. A. Rohrman and J. H. Ludwig

SULFUR IN U.S. COALS. Coal Age, p. 78-79 Dec. 1965.

Data on sulfur contents of the 507 million tons of coal and lignite shipped from mines of the conterminous United States during calendar year 1964 have been collated and analyzed by the authors. The average sulfur content of all coal distributed was found to be 1.95%. One table presented shows sulfur content of coal from mines in producing States and indicates total production tonnages of coal for various sulfur content intervals. Another table shows production in tons and life expectancy of coal mines producing coal containing 1% sulfur or less. Increased use of coal in the higher ranges will accentuate the problem of coping with sulfur dioxide in controlling air pollution.

01510

A. Martin and F. R. Barber

INVESTIGATIONS OF POLLUTION AROUND A MODERN POWER STATION. J. Inst. Fuel (London), 39(306):294-307, July 1966.

Sixteen sulphur dioxide recorders have been sited around a modern 1000 MW power station situated in a rural area. The recorder layout was in the form of a ring, the radius of which was the distance of calculated maximum ground-level pollution. The results from their operation during the period October, 1963, to September, 1964, are reported. On a long-term basis the overall average effect of the power station on the concentration of sulphur dioxide as measured at these sites was small (0.1 to 0.2 p.p.h.m.) compared with that already to be found in the area (3 to 5 p.p.h.m.). Most of the pollution appeared to come from distant cities and industrial areas. The most persistent effect from the power station, amounting on average to only 0.6 p.p.h.m., was to the north-east of the station and is thought to be due to the combined effects of wind frequency and strength in that direction. Short-term (3-min) power station contributions were often detectable, but under the dispersing effect of the wind, were not usually persistent at any one site. There was no significant pollution from the power station in stable atmospheric conditions, with or without fogs. The importance of dosage, as well as peak and mean concentrations, is discussed. It is shown that the power station pollution and background pollution are rarely additive, and that only the background has given rise to objectionable dosages. Modifications to accepted methods of calculation are proposed, to account for absolute short-term maxima recorded. (Author abstract)

01816

F.A. Rohrman, J.H. Ludwig, B.J. Steigerwald

COAL UTILIZATION AND ATMOSPHERIC POLLUTION. Coal-Wherever Coal is Concerned 19, (4) 5-7, Apr. 1965. (Presented at the American Institute of Chemical Engineers Meeting, Houston, Tex., Feb. 11, 1964.)

In discussing the timely topic of coal utilization and atmospheric pollution the authors have focused their attention on sulfur since that is the prime pollutant in coal. Several remedies are mentioned including the present trend towards locating power plants in less populated areas. Other remedies including treating the coal and/or treating the fuel gas would be applicable to existing plants. The economics of the various treatments remain to be determined. (Author abstract)

01842

D. F. Walters and D. O. Martin

AN EVALUATION OF THE AIR POLLUTION ASPECTS OF THE PROPOSED STEAM-ELECTRIC PLANT AT OAK PARK, MINNESOTA. Preprint. 1965.

The installation and operation of the 550,000 kilowatt steam-electric plant at Oak Park, Minnesota, will generate large quantities of air pollutants, principally sulfur dioxide, nitrogen oxides, and particulate matter. A 785-foot stack will be installed to permit dispersion and dilution of gaseous pollutants. Calculations indicate that ground level concentration of sulfur dioxide may cause acute damage to vegetation. However, existing information is inadequate to predict with assurance whether long-term chronic effects will be experienced by long-lived vegetation such as trees. It is expected that the human perception threshold for SO2 will be exceeded occasionally. Inversion breakup fumigation may produce ground level concentrations exceeding the human perception threshold at distances of ten miles or more. The installation and operation of a second unit of 750,000 kilowatt capacity will more than double air pollution emissions. If the 550,000 kilowatt unit is built and operated, a SO2 monitoring network should be activated. This will assist in determining the effects of SO2 on the surrounding vegetation and people, as well as provide guides for future installation design. Prevailing winds in this area are such that air pollutants will often be carried into Wisconsin. Therefore, officials of that State should take part in air pollution activities connected with the proposed plant. Plans and studies should be started now to obviate future air pollution problems indicated by plans for expansion of this plant beyond the initial 550,000 kilowatt capacity.

02014

R.E. Holl

(CONTROL OF ATMOSPHERIC POLLUTION ON EXISTING AND FUTURE SITES OF E.D.F. POWER STATIONS.) Controles de la Pollution Atmospherique Sur les Sites des Centrales Thermiques E.D.F. Actuelles et Futures. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper IV/2). pp. 84-6.

Since 1959, Electricite de France has been engaged in air pollution control on the sites of existing and future power stations, in order to measure the effects the stations have on local pollution and to establish the critical periods when special fuels must be burnt. The studies refer to deposited dusts, high acidity content of the air and black smoke. A special document gives detailed programme of undertaken research and the results obtained. (Author abstract)

02290

S.J. Keating, Jr.

SILENT, 3.75 KW, LIQUID HYDROCARBON-AIR FUEL CELL POWER-PLANT. VOL. I. TEXT (¼FINAL TECHNICAL REPT. MAR. 18, 1965 THROUGH MAR. 17, 1966). Pratt and Whitney Aircraft, East Hartford, Conn. (Rept. PWA-2816) May 24, 1966. 82 pp. DDC: AD 484196

A powerplant system was established and used to determine overall powerplant weight, volume and thermal efficiency. For a 3.75 KW net output powerplant these are 366 lbs., 14.1 cubic feet and 36% (LHV) respectively. Other studies were conducted to establish optimum system characteristics and operating parameters. System transient characteristics were established as were operating capability and limits. Tests of three of the components were run and results were evaluated to verify analytical predictions. The system sound output was analytically predicted. Finally a preliminary design layout of the powerplant was made. (Author summary modified)

02501

J. R. Garvey

AIR POLLUTION AND THE COAL INDUSTRY. Mining Congr. J. pp. 55-65. Aug. 1966.

This paper is a general review of air pollution resulting from coal combustion, whereof the oxides of sulfur are considered to be of main public concern. Author advocates realistic regulations in order to enable producers of high sulfur coals to comply with the ordinances and at the same time protect their current market.

02549

L. V. Buzunova, A. N. Bokov, A. M. Gurevich, and Z. P. Nikitinskaya

SLAG HEAPS AS A SOURCE OF ATMOSPHERIC POLLUTION. (Otvaly ugol'nykh shakht kak istochnik zagryazeniya atmosfernogo vozdukha.) Hyg. Sanit. 318 (1) 118-20, Jan. 1966. CFSTI: TT66-51160/1-3

The burning slag heaps of the coal mining districts in the Rostov Region, where the principle combustible component is anthracite, do not present any carcinogenic hazard. However, this conclusion cannot be extended to burning rocks in slag heaps containing quantities of other grades of coal, such as bituminous coal, and particularly coal which processes a higher content of tarry substances. The burning slag heaps give rise to considerable pollution of the atmosphere by carbon monoxide and sulfur dioxide.

02630

Duzy, A. F., and J. B. Walker, Jr.

UTILIZATION OF SOLID FUEL HAVING LIGNITE TYPE ASH. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines, North Dakota Univ. Symposium, Bismark, Apr. 29-30, 1965). (Information Circular No. 8304). p. 27-39, 1966.

The impurities in low-rank coals are considered. Although low-rank coals have a high volatile matter content and a low ignition temperature and are relatively easy to burn, their impurities may be quite variable or troublesome in boiler design and operation. Included are sections on types of ash; lignite-type-ash fuels; mining and preparation of lignite-type-ash coals; ash fusibility; fouling and slagging characteristics; abrasiveness and erosiveness of raw coal; upgrading coal; and standards required.

02631

Sondreal, E. A., W. R. Kube, and J. L. Elder

CHARACTERISTICS AND VARIABILITY OF LIGNITE ASH FROM THE NORTHERN GREAT PLAINS PROVINCE. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines-North Dakota Univ. Symposium, Bismark, Apr. 29-30, 1965.) (Information Circular No. 8304). p. 39-50, 1966.

The aim was to present current results of the Bureau of Mines investigation of lignite ash at Grand Forks Coal Research Laboratory. The program is described. Included are sections on the survey of ash characteristics; lignite sampling for the ash survey; analytical procedures, composition of coal ash; critical properties of lignite ash; behavior of sulfur in lignite; and trace elements in lignite ash.

02633

Peck, R. E.

SPECIAL DESIGN FEATURES OF THE LELAND OLDS POWER STATION OF BASIN ELECTRIC POWER COOPERATIVE. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines-North Dakota Univ. Symposium, Bismark, Apr. 29-30, 1965.) (Information Circular No. 8304). p. 78-89, 1966.

Some of the special design features necessary for use of lignite in the first 200,000-kw, unit in the Leland Olds power station south of Stanton, N. Dakota are described. Lignite has a lower heating value and a higher moisture content than bituminous coal, and the ash from lignite also has different characteristics. There are six special design features of the Leland Olds station's first unit which were necessitated by the nature of the lignite fuel it will burn. These features are (1) increased boiler size to produce the necessary steam for a 200,000-kw generator, (2) increased pulverizer capacity because of the special qualities of lignite, (3) inclusion of a primary air heater in the airflow system to assure proper drying of lignite in the pulverizing and combustion states (this equipment was also designed for drop-shot cleaning because of ash in the flue that gases can deposit in the heat exchangers), (4) wide separation of pendant boiler tubes to prevent bridging by ash. (5) more thermoprobes than are usual, in order to monitor temperatures and keep them in ranges which will prevent buildup of ash and clogging under either low-or-high -temperature conditions, and (6) more soot blowers than are normal for a 200,000-kw plant in order that the ash produced by lignite under certain conditions can be effectively removed. These special features are discussed in detail.

02634

Scott, D.

UTILIZATION OF LOW-RANK FOSSIL FUEL: REPORT OF SUBSECTION COMMITTEE OF THE CANADIAN ELECTRIC ASSOCIATION (IN: PROCEEDINGS ON TECHNOLOGY AND USE OF LIGNITE). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines- North Dakota Univ. Symposium, Bismarck, Apr. 29-30, 1965.) Information Circular No. 8304) p. 89-99, 1966.

A questionnaire was prepared and circulated to major coal users, including utilities in the Northern United States, where considerable research and development is being done on coal burning and associated work with low-rank fuels. Most users have run and are running into difficulties (of one form or another) due in general to the equipment not being complete enought in its design to cope with the special characteristics of the fuel used and nature of the environment. The problem areas are sectionalized, with emphasis on the most prominent problem, that of boiler fouling. Sections are included on fuel handling and storage; stoker firing; pulverized firing; slag-tap firing; fouling of furnaces; ash handling; contrifugal mechanical dust collectors; ash and dust removal; and instrumentation and controls.

02765

J.J. Schueneman C.G. Beard, II

CHARLESTON-KANAWHA VALLEY AIR POLLUTION STUDY - A DESCRIPTION. Preprint. (Presented at the 55th National Meeting, American Institute of Chemical Engineers, Houston, Tex., Feb. 7-11, 1965, Paper No. 46c.)

The Kanawha River Valley area around Charleston, West Virginia, contains one of the nation's largest concentrations of basic chemical production. The chemical processes and other industrial operations, along with substantial use of coal for fuel, have resulted in an air pollution problem. The situation is aggravated by meteorological conditions and a rugged terrain that hamper atmospheric dispersion of air pollutants. The West Virginia Air Pollution Commission and the United States Public Health Service, with many operators, have initiated a study that encompasses air quality, pollutant emissions, meteorology, effects of pollution on materials, odors, vegetation damage, and means of pollution control. The area being studied and past air pollution studies are described briefly. The organization, outline, and work plan of the present study are presented in summary form. (Author abstract)

02860

R.J. Rayliss H.M. Whaite

A STUDY OF THE RADIUM ALPHA-ACTIVITY OF COAL, ASH, AND PARTICULATE EMISSION AT A SYDNEY POWER STATION. Intern. J. Air Water Pollution 10, (11-12) 813-9, Dec. 1965 (Presented at the Clean Air Conference, New South Wales Univ. Aug. 18, 1965.)

A study has been made of the radium alpha-activity in samples of coal and ash from Pyrmont Power Station, to estimate the potential health hazard to the general population. From an examination of probable maximum concentrations at ground level, it is considered that any hazard to health, by inhalation of radio- active material, is negligible.

03072

T. R. Brogan and P. Dragoumis

THE DEVELOPMENT OF MHD POWER GENERATORS. Preprint. (Presented at the National Coal Association Technical-Sales Conference and Bituminous Coal Research, Inc., Annual Meeting, Pittsburgh, Pa., Sept. 14-15, 1966.)

The promise of the MHD concept lies in improving the efficiency of converting the energy of our primary fuels to electricity. Although MHD may find ultimate application with nuclear fuel, only combustion-driven generators are deemed practical for early development. Both the projected economic performance of nuclear power and the growing concern over environmental pollution greatly enhance the need for a highly efficient more economical coal-fired generating system. By burning less coal per unit of energy output, less sulfur will be discharged to the atmosphere. Then, too, the economic necessity for efficient recovery of the seed material and the simple and inexpensive method developed for effecting this recovery, will insure that the MHD plant effluent is thoroughly cleansed of particulate matter. With regard to the formation and emission of various oxides of nitrogen the performance of MHD cannot be easily predicted at this time. Clearly, the equilibrium concentration of nitrogen oxides at the combustion of that which we wish to release directly to the atmosphere. It is not at all certain that equilibrium will, in fact, be attained in the combustion chamber. Beyond this, there is also a question as to the extent to which any concentration of nitrogen oxides will be 'fixed' in the subsequent expansion through the MHD generator and stream generator. It is therefore not certain at present, what means should be utilized to best control the amount of fixed nitrogen which ultimately reaches the stack. Measurements indicate that the concentration of nitrogen oxides the effluent from MHD power plants burning coal with atmospheric air preheated to 1000 F will be of the same order of magnitude as from conventional power plants today. For use of significantly higher flame temperatures attained with higher preheat, careful attention must be given to MHD generator design and operation to control the nitrogen oxide concentration in the flue gas. The relatively small size of the MHD combustion chamber which results from the combustion process can make it possible to exercise precise control over the gas composition. The development of MHD has reached the point where the construction and operation of an experimental MHD power plant, duplicating, at a level of about 30 MW, all of the features of a commercial MHD power plant, is technically feasible and justified by the ultimate promise of the concept.

03113

R.W. Gerstle, S.T. Cuffe, A.A. Orning, C.H. Schwartz

AIR POLLUTANT EMISSIONS FROM COAL-FIRED POWER PLANTS, REPORT NO. 2. J. Air Pollution Control Assoc. 15, (2) 59-64, Feb. 19659

The Public Health Service and the Bureau of Mines are conducting a joint study to evaluate a number of flue-gas-stream components from coal-burning power plants. Emissions of fly ash, sulfur oxides, nitrogen oxides, polynuclear hydrocarbons, total gaseous hydrocarbons, formaldehydes, certain metals, and carbon dioxide are determined. A previous paper covered air pollutant emissions from vertical-fired and front-wall- fired power plant boilers. This paper includes a comparative evaluation of emissions from a tangential-fired and a turbo-fired power plant boiler. (Author abstract)

03340

J. A. DeCarlo, E. T. Sheridan, and Z. E. Murphy.

SULFUR CONTENT OF UNITED STATES COAL. Bureau of Mines, Washington, D.C. (Information Circular 8312.) 46 pp., 1966 GPO 913-499

The sulfur content of United States coals varies widely, ranging from a low of 0.2 percent to as much as 8.0 percent as mined, by weight, on a dry basis. Perhaps as important as the amount of sulfur, however, is the manner in which sulfur occurs. Generally, sulfur is present in coal in three forms: as organic combinations, as pyrite or marcasite, and as sulfates. The forms of sulfur are important because they generally indicate whether any appreciable reduction in sulfur can be achieved through conventional cleaning processes. Sulfur held in organic combinations generally cannot be separated from the coal substance by conventional cleaning. Sulfate sulfur is generally quite low and usually is of no great concern. The pyritic sulfur, however, can vary from a low of 40 percent ot as high as 80 percent of the total sulfur. Some reduction of pyritic sulfur can be achieved by crushing and various cleaning processes, depending upon the manner in which it is dispersed in the coal. This report attempts to show the sulfur content of the coal presently produced in the United States and to assess the remaining reserves of the various ranks of coal in each State, according to sulfur content. All data compiled in this review were obtained from industry surveys of the Bureau of Mines and from U.S. Geological Survey and various State geological survey publications. (Author Introduction modified)

03587

AIR POLLUTION IN THE IRON AND STEEL INDUSTRY. Organisation for Economic Co-Operation and Development, Paris, France. June 1963. 135 pp.

The Iron and Steel Committee of the Organisation for Economic Co-Operation and Development (O.E.C.D.) has investigated air pollution problems in the industry from the following aspects: technical, Economic, and financial considerations. A discussion of the general considerations of ambient pollutants, the measurement methods employed in air pollution determination, gas cleaning equipment and chimneys, air pollution in the iron and steel industry, observations in iron and steel works throughout Europe and, legislation and organization of future research are included.

03867

WORLD POWER DATA (CAPACITY OF ELECTRIC GENERATING PLANTS AND PRODUCTION OF ELECTRIC ENERGY). Federal Power Commission, Washington, D.C. 1964. 16 pp.

Statistics are presented on elect
generating capacity and electric energy production for almost all countries of the world and a number of their dependencies for the years 1963 to 1964. Altogether, a total of 147 countries or dependencies are covered. All of the figures on capacity and production represent combined total s for electric utilities and industrial establishments having generating facilities forproviding all or part of their own requirements. Total world production of electric power in 1964 amounted to 3.023 trillion kilowatt hours, an increase of 230 billion kilowatt-hours - or 8.2% - over 1963. Of the toal world production, 819 billion kilowatt-hours, or 27%, were produced by hydroelectric plants. With only 6 percent of the world's population, the United States accounted for 36 percent of the world's electricity output in 1964. The next six leading countries combined produced another 38 percent. Thus, the seven countries generated almost three-fourths of the total, yet their combined population was just over one-fifth of the world total. World per capita production of electric power in 1964 amounted to 931 kilowatt-hours, an increase of 53 kilowatt-hours per capita over 1963. On the basis of per capita production, the United States dropped from fourth to fifth place among the world's highest electric power producers. If total energy consumption per capita, a more accurate indicator of economic development, were used as a basis of comparison, a different grouping of the nations would result than that shown. The United States, for example, ranks above any other country of the world in terms of total energy use per capita. The principal compilation presents, for each country, 1963 and 1964 data on installed electric generating capacity and production as well as population and kilowatt-hours per capita. The predominant frequency of the current in each country is also indicated.

04224

TUFTS COVE - DUAL FIRING AND CYCLONE FURNACES FOR 100 MW UNIT NOVA SCOTIA. Eng. Boiler House Rev., 81(8):234-238, Aug. 1966.

Tufts Cove thermal generating station was commissioned on September 30, 1965 as a new power source for Nova Scotia in Canada. The steam generating unit is a Babcock and Wilcox cyclone-fired radiant type boiler having a continuous steaming capacity of 725,000 lb hr. The design pressure of the unit is 2,100 lb/sq in g with operating steam conditions of 1,850 lb/sq in g and 1,010 F at the superheater outlet and a reheat steam temperature of 1,010 F at the reheater outlet. The overall effeciency of the unit, at a steam flow of 650,000 lb/hr is 90.3 per cent when burning Cape Breton coal. This cyclone fired steam generating unit was selected for Tufts Cove Station on its suitability for the burning of Cape Breton coal. The flue gas leaving the air heater passes through an electrostatic precipitator which has a collection efficiency of 95 per cent. The dust loading of the flue gas leaving the precipitator is guaranteed no to exceed 3.25 lb of dust per 1,000 lb of flue gas adjusted to 12 per cent CO29. The steam generating unit is equipped with a Diamond automatic sequentially-operated, steam blowing sootblower system with 11 retractable blowers in the superheater-reheater section, 4 rotary element blowers in the economiser section, 2 non-rotating retractable blowers in the air-heater cold section and 22 short retractable furnace wall blowers. The fly ash collected by the precipitator is of a very fine grain size, approximately 95 per cent under 50 microns in size. Due to the fineness of this ash and the disposal problem it may present, the unit is equipped with an ash refiring system. This system conveys the fine precipitator ash back to the cyclone furnaces, where it is melted back to liquid and disposed of as slag into the slag tank. The most prominent physical feature of the plant site is the 500 ft high chimney, which consists of a steel reinforced concrete column surrounding an independent brick lining. The height was decided upon following extensive wind tunnel tests on scale models of the surrounding terrain carried out to determine the effect of flue gas dispersal of various chimney heights. The final cost of the project will be approximately 17,000,000.

04287

A. P. Baranov

NEW X SOURCES OF ELECTRICAL ENERGY FOR SHIPS. (Novyye Istochniki Elektricheskoy Energii dlya Sudov.) Sudostroyeniye Shipbuilding House, Leningrad, U.S.S.R. 1965. 120 pp. Russ. (Tr.) CFSTI, DDC: AD 630-285

This book, which is the result of an analysis of a great many articles and much information which is scattered and narrowly specialized in nature, as well as of some work done by the author, has attempted to provide basic, and systematized, information on questions dealing with theory, design arrangements, the characteristics of thermoelectric, thermal emission, magnetohydrodynamic, electrochemical generators, and the possiblilities of using these generators on board ship.

04333

Jones, J. R.

CONTRIBUTION OF THE COAL INDUSTRY TO SOLVING THE PROBLEM OF AIR POLLUTION CONTROL. Proc. Am. Power Conf. 27, 126-36, Apr. 1965. (Presented at the 27th Annual Meeting, American Power Conference, Chicago, Ill., Apr. 27-9, 1965.)

The efforts of the coal industry to combat the problem of stack emissions are highlighted. Industry research on sulfur has focused on the removal of oxides from flue gases and removal of sulfur from raw coal. Research aimed at learning more about the forms and occurrence of sulfur in coal is continuing.

04652

P. A. Berman J. O. Stephens

(ADVANCED COMBINED CYCLE GAS TURBINES FOR ELECTRICAL POWER PLANTS.) Turbinas de Gas Avanzadas para las Centrales Generadoras de Ciclo Combinado. Dyna (Madrid) 41, (11) 623-6, Nov. 1966. Sp.

The improvements in gas turbine design over the last twenty years are described and future developments are indicated.

The simple cycle gas turbine in combination with a steam generating unit in the combustion zone surpasses the performance of the conventional steam plant. With the great increase in the efficiency of the gas turbine with intermediate water cooling and reheating, the utility plant has a highly fexible, efficient method for obtaining electrical power.

04778

G. F. Kennedy

UNITED STATES POWER-PLANT DESIGN TRENDS: 1965. Proc. Inst. Elec. Engrs., London 113, (1) 149-59, Jan. 1966.

The paper outlines the trends in the design of large units of generating plant in the United States at the beginning of 1965. Unit sizes continue to rise, and supercritical steam conditions, with pressures around 3500 lb/sq in and temperatures in the 1000-1050 F region, are now nearly always adopted for units of above 400 MW capacity. Great attention is paid by the makers of boilers and of turbines to secure higher availability, because it is now recognized that, as size increases, so does the difficulty of tracing faults which may arise in operation, and outage time means money. The trend to larger units is encouraged by lower overall costs per kilowatt, and users are attempting to reduce this still further by the adoption of 100% duty auxiliaries where possible, and careful layout of auxiliary plant. The mechanism of boiler-tube breakdowns is now more widely understood, and the tendency is to equip all high-pressure units with condensate polishing plant. More attention is being paid to the elimination from stack effluent of undesirable products of combustion. The position with regard to computer control of large units is now static, because of difficulties with early units and high prices of computer equipment. The tendency for manufacturers to increase boiler ratings is being resisted by users, particularly of coalfired boilers. Much greater attention is being given to the supervision of shop and site welding techniques, in an attempt to avoid boiler outage during operation. (Author abstract)

04937

INFORMATIVE AIR POLLUTION PROBLEMS IN FLY ASH SINTERING PLANT (INFORMATIVE REPORT NO. 6). J. Air Pollution Control Assoc. 15, (3) 123-4, Mar. 1965.

The fly ash sintering plant at the Astoria Generating Station of Consolidated Edison is described. The dust pollution problems and the corresponding control methods are also described

05011

A. A. Orning, C. H. Schwartz, and J. F. Smith

MINOR PRODUCTS OF COMBUSTION IN LARGE COAL-FIRED STEAM GENERATORS . American Society Mechanical Engineers New York Paper 64- wA/FU-2. (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 29-Dec. 4, 1964 .)

An analysis is given of the minor products of combustion from large coal-fired steam generators in relation to thermodynamic equilibria, unit design and operating conditions. Concentrations of nitrogen oxides and the ratios of sulfur trioxide to total sulfur oxides are near equilibrium values at the furnace outlet. Significant amounts of low molecular weight organic acids and comparatively small amounts of polynuclear aromatic hydrocarbons are found under good combustion conditions. (Author abstract)

05067

S. T. Cuffe, R. W. Gerstle, A. A. Orning, and C. H. Schwartz

AIR POLLUTANT EMISSIONS FROM COAL-FIRED POWER PLANTS; REPORT NO. 1. J. Air Pollution Control Assoc. 14, (9) 353-62, Sept. 1964 (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

Air pollutant emissions from two types of coal burning power plant furnaces were studied. Particulates entering the fly-ash collector from the low-intensity-mixing, vertically fired boiler of Unit A accounted for 60% of the ash contained in the coal charge. In the high-intensity-mixing, horizontally fired Unit B, 85% of the total ash entering the boiler in the coal was carried to the fly-ash collector. The fly-ash collectors effectively removed 85 to 95% of the particulate matter and showed essentially the same efficiency in removal of common trace metal compounds. Concentrations of sulfur trioxide ahead of the dust collector varied widely. For Unit A, the vertically fired boiler, they averaged about 4% of the SO2 concentration; for Unit B, the horizontally fired boiler, formation of SO3 was lower, averaging less than one percent of the SO2 concentration. The fly-ash collectors effected an appreciable reduction in sulfur trioxide emissions on Unit A but not on Unit B. For both units SO3 emissions were less than one percent of their SO2 emissions. Nitrogen oxide concentrations during normal full-load operation were increased 30 to 40% by passage through an electrical precipitator. Organic acid concentrations were appreciably higher than those of gaseous hydrocarbons, formaldehyde, and carbon monoxide. The very small concentrations of gaseous hydrocarbons, formaldehyde, and carbon monoxide indicated very complete and efficient combustion during both full-load and partial-load operation. Emissions of polynuclear hydrocarbons from large power plant boilers were found to be very small in comparison with those from smaller coal-fired units having less efficient combustion processes.

05169

H. M. Raynor, and L. P. Copian

SLAG TAP BOILER PERFORMANCE ASSOCIATED WITH POWER PLANT FLYASH DISPOSAL . Western Electric Co., Chicago, Ill. and Riley Stoker Corp., Worcester, Mass. 1959, 24 pp.

Background information is presented on industrial steam plant and the circumstances leading to installation of a slag tap boiler. The performance characteristics of the slag tap unit are described. The features of flyash reinjection from its own dust collector and also dust collectors of adjacent dry bottom units are exhibited. The main purpose of the slag tap unit, besides furnishing the required quantities of steam, was to provide a means of economically disposing of the large quantities of bottom ash and flyash resulting from its own operation; and also the disposal of flyash from the other units in the station. According to the performance tests, the slag tap unit is performing this function very well. The tests to date have shown that it can slag all of its own ash and flyash from two other boilers with no appreciable increase in dust loading. This slagging operation can be carried out through a wide load range. The studies have also pointed up the fact that proper introduction of flyash into the furnace for slagging is important in order to retain low dust loadings. The maximum limit of reinjecting flyash from other boilers was not determined in this series of tests. However, by extrapolating the data collected, the reinjection limit is equivalent to more than 425,000 lbs. per hr. steam rate from the dry bottom units. Hence, the Riley Turbo Furnace boiler is capable of handling flyash from almost three (3) dry bottom units of equivalent capacity.

05506

J. B. Kirkwood

THE DESIGN OF CHIMNEYS TO ENSURE EFFECTIVE DISPERSAL OF POWER STATION EFFLUENTS. Proc. Clean Air Conf. Univ. New South Wales, 1962, Paper 11, Vol. 1, 17p.

The power stations now being constructed and planned in New South Wales will be of such large capacity that if troublesome pollution is to be avoided they must be provided with chimneys which will achieve effective dispersal of both dust and gaseous effluents. The present practice of The Electricity Commission of New South Wales is to employ chimneys having a minimum height equal to 2 1/2 times that of power station buildings together with a gas exit velocity of 50-60 ft. Estimates are presented of the rate of dust deposition and concentrations of sulphur dioxide in the vicinity of a chimney serving 400 MW of generating plant and these indicate that neither dust deposition nor sulphur dioxide should be troublesome in the vicinity of future power stations. Further, it is concluded that the plume from a power station chimney of this size probably will penetrate a high propertion of atmospheric inversions in the coastal area of New South Wales. Troublesome pollution which has occurred in the vicinity of power stations in New South Wales has largely been associated with excessive dust deposition resulting from inadequate dust collecting equipment. Another investigator has dealt with investigations carried out by The Electricity Commission of New South Wales with a view to improving the performance of electrostatic precipitators used for the collection of fly ash from pulverised fuel fired boilers. As a result of this work it is anticipated that undue dust deposition will not occur in the vicinity of future power stations AA)

05530

R. J. Creagan

PROTECTING AIR RESOURCES WHILE MEETING POWER DEMANDS FOR TOMORROW'S CITIES THROUGH THE USE OF ATOMIC ENERGY. Proc. Sanitary Eng. Conf., Air Resources Planning Eng., Pitts- burgh, Pa., 1965, pp. 67-103.

The purpose of this paper is to indicate how future electrical utility power requirements can be met with nuclear power plants without adversely affecting the air resources of the community in volved. Utility power requirements and the necessary ore re sources available are indicated. A typical reactor is described and the associated nuclear power economics are given. Engineered safeguards are described with respect to their ability to protect the air environment both under operating and under assumed fuel meltdown conditions so that the extremely low radiation levels specified in the pertinent code of Federal Regulations are not exceeded.

05846

P. J. Adams

DEVELOPMENT AND INITIAL OPERATION OF OCR PACKAGED COAL-FIRED BOILER 20,000 TO 50,000 LBS./HR. Preprint. (Presented at the Industrial Coal Conference, Lafayette, Ind., Oct. 8, 1964.)

Design criteria for capacity, pressure, temperature, rail transportability, efficiency, coal, load range, and stack discharge with dust collectors are stated. Design limitations of size, stoker size, furnace volume, gas pass areas, reinjection, stack discharge collector are outlined. Specifications for the final design are tabulated. The most notable achievement was the operation of an entirely new product to burn coal with almost no start-up difficulties whatever.

06040

PRESENT STATUS OF PUBLIC NUISANCE IN ELECTRIC POWER INDUSTRY OF JAPAN. Central Power Council, Japan, Overseas Public Nuisance Study Mission, Sept. 1965. 25p.

The status of SO2 and dust fall in Japan is reviewed. The examples of Yokkaichi and Ube City are cited. The national legal and administrative aspects are discussed. The electric power industry of Japan is described. The anti-pollution measures taken by the electric power industry are outlined including research programs on diffusion, SO2 removal from stack gases, prevention of acid smut, and desulfurization of fuel oil.

06351

R. F. Abernathy and F. H. Gibson

RARE ELEMENTS IN COAL. (Bureau of Mines, Washington, D.C.) (Information Circular 8163). (1963). 73 pp.

Data are presented showing trends in the content of chlorine, phosphorus, titanium, and manganese although these elements are not included in the category of rare and uncommon elements in coal. It is suggested that elements may be called rare when the amount in the earth's crust is not much greater than 0.01 percent. By uncommon is meant unusual concentrations of elements greater than normally occur in the mineral matter of coal. The occurrence of 34 elements in coal is reviewed. These do not include the elements silicon, aluminum, iron, calcium, magnesium, sodium, potassium, and sulfur, which constitute the main part of the mineral matter in most coals. Some of the rare elements found in coal probably were derived from the original coal-forming plant material. Elements occuring in sufficient concentration to be detected as minerals usually are considered as extraneous substances deposited in coal beds from external sources. Three main stages of the enrichment of elements in coal are suggested: (1) Concentration during the life of the plants; (2) concentration during decay of the plants; and (3) concentration during mineralization of the coal. There are three hundred eighty (380) references.

06978

H. E. Shafer, Jr. C. T. Holland

WESTERN STATES COAL-ASSOCIATED MINERAL OCCURRENCES LIKELY TO BE A FACTOR IN LONG RANGE AIR POLLUTION CONSIDERATIONS.((West Virginia Univ., Morgantown, School of Mines.)) (Rept. No. 7.) (Presented at the Fall Meeting, Society of Mining Engineers and Rocky Mountain Minerals Conference, Phoenix, Ariz., Oct. 7-9, 1965.) (1965). 13 pp.

The outlook for future coal consumption and the air pollution problems conncected with it are discussed. Some control methods currently employed by coal burning installations are mentioned as well as utilization of by-products such as flyash. Opposition is voiced against the control of sulfur dioxide emission from coal by limitation of the sulfur content. It is felt that with suitable stack height and reasonable limits at ground level, specific coals with considerable sulfur content can be burned without providing unhealthful atmospheres. Also discussed is the emission of radioactive elements from power plants using organic fuels. It is concluded that coals from the western states can be expected to produce similar air pollutants as coals produced elsewhere, with the exception of uranium, which may be present in some western coals in higher concentrations.

07570

Kireeva, I. S.

ATMOSPHERIC POLLUTION WITH 3,4-BENZPYRENE IN THE VICINITY OF A COAL BRIQUET FACTORY. (O zagryaznenii atmosfernogo vozdukha 3,4-benzpirenom v raione briketnoi fabriki.) Text in Russian. Gigiena i Sanit., 30(7), July 1965. 9 refs. Engl. transl. by JPRS, Hyg. Sanit., 307):126-128, July 1967. CFSTI: TT66-51033/3

An investigation was conducted of a large briquet factory which uses 11% coal pitch for the binding of coal fines, so that the 3,4-benzpyrene content in the coal briquets reaches 0.14%. The process of briqueting includes crushing bituminous coal and pitch, mixing them in a certain ratio, and molding the briquets. Determinations were made of the amounts of 3,4-benzpyrene in the gases discharged by the press shop, in the atmosphere, and in the dust falling at distances of 200 to 1000m from the factory. Tarry substances were extracted with pure nonfluorescent benzene and fractionated on a chromatographic column with an activated aluminum mixture. Identification of 3,4-benzpyrene was accomplished by comparing the fluorescence spectra of the individual fractions frozen in liquid nitrogen against the fluorescence spectrum of a standard 3,4-benzpyrene. The quantity of the latter was determined photoelectrically. Thus, 3,4-benzpyrene was found in all samples within the radius of 1 km from the factory, the concentration decreasing regularly with increasing distance from the factory. However, concentrations exceeded the control determinations made on the windward side (0.14--0.30 microgram/100 cu. m.) even at a distance of 1000 m. The results indicate the need to eliminate coal pitch from the technological process and introduce a new briqueting technology using noncarcinogenic grades of petroleum bitumens as the binder.*

07642

Gerber, Abraham

THE ECONOMICS OF COAL SUPPLY. American Chemical Society, Pittsburgh, Pa., Div. of Fuel Chemistry, Preprints, 9(2):18-22, 1965. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics Joint with Division of Chemical Marketing and Economics, Detroit, Mich., April 4-9, 1965.)

The status of coal in the fuel market and the factors involved in its decline and acceleration are examined. The efforts of the coal and transportation industries to reduce the delivered cost of coal are described. The growth of the electric utility industry and the resulting effect on coal consumption is discussed. The problem of finding an economical means of elimination the harmful effects of coal combustion products is also discussed. The wide range of substitution capabilities among the several sources of energy, and most importantly the advent of nuclear power as a competitive source of energy in coal's largest market, can be expected to elicit the technical and economic responses from both the coal and transportation industries that will make possible a rising level of coal use without significant increases in real costs.

07644

Wagner, H. A.

UNCONVENTIONAL ENERGY CONVERSION METHODS. American Chemical Society, Pittsburgh, Pa., Div. of Fuel Chemistry, Preprint, 9(2):94-103, 1965. 5 refs. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics Joint with Division of Chemical Marketing and Economics, Mich., April 4-9, 1965.)

The recent accomplishments in the field of direct energy conversion are important to the power industry since the potential rewards of lower costs are substantial. The increasing amount of total energy required to meet the increasing demands in the chemical industry will dictate some new and unconventional approaches when reviewing future production costs. Four of these new methods of power production offer promise of commercial application to power system generation as a means of reducing production costs. The economic and technical status are discussed for the following methods: (1) thermoelectric, (2) thermionic, (3) fuel cells and (4) magnetohydrodynamics.

07645

Robinson, Myles E.

SOME ASPECTS OF THE TRANSPORTATION OF BITUMINOUS COAL. American Chemical Society, Pittsburgh, Pa., Div. of Fuel Chemistry, Preprints, 9(2):127-147, 1965. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics Joint with Division of Chemical Marketing and Economics, Detroit, Mich., April 4-9, 1965.)

An examination of the changes in the transportation pattern of bituminous coal is presented. Statistics in the last seven years have permitted the analysis of coal distribution by method of transportation, by user category and by district of origin and states of destination. Tables are presented for each of the three methods. The transportation patterns for coal in the U.S. range from the railroads which handle some three-fourths of all shipments through water and motor carriers, to the pipeline. Because of its confinement to one producer and its relatively limited life, the pipeline does not lend itself to statistical trending but it is briefly discussed. Distribution for the electric utility market has a more complete accumulation of data so it is discussed in greater detail.

07647

Vogely, William A.

PATTERN OF ENERGY CONSUMPTION IN THE UNITED STATES. American Chemical Society, Pittsburgh, Pa., Div. of Fuel Chemistry, Preprint, 9(2):205-221, 1965. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics Joint with Division of Chemical Marketing and Economics, Detroit, Mich., April 4-9, 1965.)

The pattern of flows of energy through the economy of the United States is an ever changing one. Major shifts in sources of energy and the uses to which energy is put have occurred since the beginning of our industrial economy. Within a decade and a half (1947-1962) there were factors which created a very different set of energy flows for 1962 from that of 1947. These changes are examined, hypotheses concerning them are presented, and projections to 1980 of the pattern are made. Two views of the energy economy are presented in tables. The first shows total energy resource consumption by consuming sector by function. Projections to 1980 are given for each view. The concluding portion presents a tentative hypothesis concerning competition among energy sources and energy trends.

07759

Rohrman, F. A., J. H. Ludwig, and B. J. Steigerwald

LOW-SULFUR RESID SUPPLIES FALL FAR SHORT OF U.S. NEEDS. Preprint from Oil Gas J., 2p., Aug. 15, 1966.

U. S. refiners are faced with a big demand for low sulfur residual oils, which cannot be supplied in the desired quantities at current levels. Because price structures relegate residual fuel to a by product status, domestic refiners have been cutting down on residual yields. The sulfur contents of domestic-refined residual oil were obtained by a poll of over 99% of all U.S. refining capacity. The results of which are given. One of the purposes was to determine if additional sources of low-sulfur residual oil might be economically marketable to some of the large users on the East Coast. Various amounts of crudes from these foreign sources are imported into the U.S. under import allocations. Generally these are blended with high-sulfur crudes from the Near East or Venezuela before refining. Only one refinery is known that refines a foreign, low-sulfur crude to produce a very low-sulfur resid. This one is located on the Pacific Coast. Domestic crudes are subjected to many different techniques dictated by several different economic motivations. The new basic oxygen process for the open-hearth steel furnaces will use less residual oil fuel--also, the strict sulfur limitations on fuels in certain areas and the greater profit in making light ends all tend to discourage the production of residual oil. Considering the very great demand for residual oil in electric-power generation, coupled with future requirements for low-sulfur fuels, the nation is certainly faced with a dilemma. The answer may lie in desulfurization, blending of resids with the lighyer oils that are lower in sulfur, shipments of low-sulfur resids from areas of high freight cost, refining of low-sulfur crudes separate from high-sulfur crudes, mineral additives (dolomite, magnesium oxide) at the power plant, removal of sulfur oxides from the stack effluent, or some combination of these.

07793

Lundquist, Nils-Henrick

DEFENSE RESEARCH INSTITUTE BRIEFING ON CURRENT SOURCES. ((Stromkallor.)) Text in Swedish. FOA Orienterar Om Stromkallor, No. 5:1-39, 1966. English translation by the Translation Div., Foreign Technology Division, Wright- Patterson AFB, Ohio, Translation No. HT-6600519, 88p., 1966. CFSTI/DDC: AD 806927

All types of current sources from Volta's pile to the fuel cell of the space age are discussed. The historical development of the battery is briefly touched upon. Batteries are grouped into pri mary and secondary, the former being based on irreversible reac tions and the latter on reversible reactions. The composition of various types of batteries is given with the aid of photographs and diagrams. Different applications are cited for the battery. Fuel cells are discussed. The advantages and operation of the fuel cell are examined. In the final sections of the article the following current sources are discussed with pictures and diagrams: thermogenerators, solar cells, thermionic generators, MHD generators, atomic batteries, and biological batteries. (Author's abstract, modified)

07800

Palo, George P. and Donald B. Weaver

TVA'S FIRST NUCLEAR PLANT. Power Eng., 71(4):38-42, April, 1967.

Scheduled for commissioning in Oct. 1970, general design and layout of TVA plant at Wheeler Reservoir, southwest of Athens, Ala, are discussed; unusual technical features are elimination of stretch concept, increase in reactor core power density, stack construction, and two units being built simultaneously with startup dates a year apart. (Authors' abstract)

07963

Rohrman, F. A., B. J. Steigerwald, and J. H. Ludwig

POWER PLANT AND OTHER SULFUR DIOXIDE EMISSIONS; 1940-2000. Preprint, Public Health Service, Cincinnati, Ohio, Division of Air Pollution, ((13))p., ((1965)). 21 refs.

Major sources, potential sources, estimated annual emissions and the effects of probable control efforts of Sulfur Dioxide to the year 2000 are discussed. The major sources include power plant operation (coal and oil); other combustion of coal; combustion of petroleum products (excluding power plant oil; wmelting of ores; petroleum refinery operation; coke processing; sulfuric acid plants; coal refuse banks; and refuse incineration). Annual emission of Sulfur Dioxide is 76.0 million tons. To indicate a range of estimated future sulfur dioxide emissions, two control schedules were selected for application to the major sources of SO2 from the current year to the year 2000. Maximum SO2 emissions will probably occur between 1975 and 1985 for the range of control schemes postulated.

08388

V. E. McKelvey, D. C. Duncan

UNITED STATES AND WORLD RESOURCES OF ENERGY. Am. Chem. Soc., Pittsburgh, Pa., Div. Fuel Chem., Preprints, (2):1- 17, 1965. (Presented at the 149th National Meetings, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics, Detroit, Mich., April 4-9, 1965.)

Energy resources must be viewed as a range extending from reserves in known deposits minable at present prices to resources that may become usable in the future through further exploration and technologic advance. Appraised in this framework, domestic resources of the fossil fuels of the types now considered usable contain 5.5 to more than 130 Q (i.e., 10 to 18th power Btu), and if very low grade organic-rich deposits are included, the potential may be more than 1,600 Q. World resources contain about 23 to more than 475 A, and if very low grade resources are considered the potential may be more than 20,000 Q. The energy potential of uranium resources in the United States ranges from about 0.16 ot more than 280,000 Q, the larger figure depending not only on the use of low-grade ore but also on the successful development of the breeding process. The energy potential of world uranium resources similarly ranges upward from 0.34 Q to an order of magnitude (31.5%) had worked in the mercury mines for up to five years; United States ranges from 7 to 420,000 Q, and of the world from 48 to about 7 million Q. In nuclear fusion can be controlled for power generation, the potential energy from resources of deuterium and lithium are orders of magnitude larger than the fissionable mineral resources. Deuterium alone contains potential energy of 7.5 billion Q. Water power, geothermal energy, solar energy, and tidal power also represent large potential sources. The almost staggering contrast between the magnitude of known reserves minable at present prices and potential resources minable only at higher prices or more advanced technology underscores the critical importance of research, exploration, and development in meeting future needs. (Author0s abstract)

08390

H. E. Benson, C. L. Tsaros

CONVERSION OF FOSSIL FUELS TO UTILITY GAS. Am. Chem. Soc., Pittsburg, Pa., Div. Fuel Chem., Preprints, 9(2):104-113, 1965. 9 refs. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics, Detroit, Mich., April 4-9, 1965.)

Natural gas has nearly completely replaced the use of coal as a source of utility gas in the United Sates. The production of gas from coal, shale, and distillate and residual oils is discussed in terms of conversion costs. The following processes for converting coal to gas are described in detail; (1) Lurgi gasification, (2) Hydrogasification, (3) Hydrogasification and the steam-iron process. The raw material costs and the plant investments for gas made by these processes are tabulated. Estimates of gas costs averaged for a 20-year period, indicate that with an improvement in coal gasification technology, it would be possible to decrease the cost of utility gas made from coal by $0.43 per thousand cubic feet for a 90 x 106 BTU/Day plant. Next is described the process for the conversion of shale oil to gas. This can be accomplished by two means: (1) to hydrogenate the shale directly, (2) to retort the material first and then hydrogenate the shale oil. Process schemes are shown for these routes. The hydrogenation of the oil and the difficulties involved are described. A summary is given of: raw material requirments, plant investments and gas price. This shows that utility gas can be manufactured by the hydrogasification of oil shale at a reasonable cost. The most important process variable influencing the cost of utility gas is the hydrogen/shale ratio.

08391

M. D. Schlesinger, G. U. Dinneen, S. Katell

CONVERSION OF FOSSIL FUELS TO LIQUID FUELS. Am. Chem. Soc., Pittsburg, Pa., Div. Fuel Chem., Preprints, 9(2):120-126, 1965. 12 refs. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics, Detroit, Mich., April 4-9, 1965.)

Supplies of crude petroleum and natural gas, although abundant, are not inexhaustible, and provision is being made for the time when our vast coal and oil shale reserves will be called upon to supply a significant quantity of liquid fuels. The approach on coal research has been to continue theoretical and practical studies to reduce costs by improving stages in the process or by developing new processes. Studies were made in the following areas: coal hydrogenation, gas synthesis, oil shale retorting systems, and bituminous sands and other hydrocarbons. A flexible, integrated plant might emphasize production of different fuels or byproducts under different economic conditions and even at different times of the year. To reduce hydrogen requirements, an alternative is the partial conversion of coal whereby most of the hydrogen is utilized as a hydrocarbon product. The char product is used for generating power or making additional hydrogen by gasification. In recent years, oil shale research by the Bureau of Mines has been limited to small scale laboratory studies on refining analysis. The cost of producing gasoline from oil shale is almost competitive with gasoline from petroleum on the West Coast. One of the main problems is the isolated location of major deposits. The recent process developments discussed have added more to refined technology rather than to significant savings in cost. It has been amply demonstrated both in the United States and elsewhere in the world, that liquid fuels can be made from coal. Except in isolated cases, costs are too high for coal to be a real contender with petroleum at current prices. Only by continued research will the remaining problems be solved.

08392

J. D. Clendenin

THE UTILIZATION OF COAL. Am. Chem. Soc., Pittsburg, Pa., Div. Fuel Chem. Preprints, 9(2):222, 1965. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics, Detroit, Mich., April 4-9, 1965.)

A brief survey is presented of current and prospective utilization of coals including lignite, (1) in the production of metallurgical, chemical and specialty cokes, (2) as fuel for process steam, space and home heating, locomotives and ship bunkers, (3) In the manufacture of industrial producer gas and gas for chemical synthesis, (4) as fuel in cement and lime kiln firing, (5) at steel and rolling mills and (6) in a variety of specialty and/or non-fuel uses, including industrial carbons, active carbon, fillers, filter aids and media, water treatment, foundry facing, road building, roofing and coating applications, barbecue briquets, fertilizer and soil conditioner, coal-based plastics, etc. Insofar as possible, information is presented on process and product research and other developments that may affect coal utilization, favorably or unfavorably, in the areas cited. Since economics of coal utilization cannot be divorced from economics of coal supply and transportation, these are touched upon briefly. (Author's abstract)

08393

John M. Ryan

UTILIZATION OF PETROLEUM AND PETROLEUM PRODUCTS. Am. Chem. Soc., Pittsburg, Pa., Div. Fuel Chem., Preprints, 9(2):223-230, 1965. 6 refs. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics, Detroit, Mich., April 4-9, 1965.)

In discussing utilization of petroleum, the existing or potential technology of oil consumption must be considered, also the effects of potential changes in supply and of new competitive forces. The demand for petroleum products in the U. S. will probably grow at a rate of 2 or 3 per cent a year. Abroad the annual growth rate will be perhaps twice as great as the rate in the U. S. 50% of all the oil consumed in the U. S. is used in the transportation sector. The growth rate will be limited by the growth of the market. General industry and power plant use constitute a second market, accounting for 7% of steam and electric power plant fuel, and 13% of the manufacturers' heat and power market. Another major market is residential and commercial consumption in which oil supplies about one third of the total energy consumed. Resources will not be a limiting factor either in the U. S. or the free world and there should be no significant shift in relative fuel prices in the foreseeable future. It is unlikely that oil demand will be increased appreciably in the U. S. through research in utilization. Research on improved exploratory and productive techniques will probably have a greater influence on domestic oil demand than will research on oil utilization. The changes in oil utilization which appear most probable will not alter the growth rate of oil demand in the Y.S. so much as its composition. Finally, some research is being conducted today on the supposition that crude oil is in limited supply and hence that refined product prices are likely to rise in the near future relative to prices of competing fuels.

08641

Sullivan, K. M.

THE OPERATION OF A VEKOS POWERMASTER COAL-FIRED FIRETUBE PACKAGE BOILER. Clean Air (J. Clean Air Soc. Australia New Zealand) 1(1):17, 19-23,25, 1967.

Tests using bituminous coal from New S. Wales were carried out on a coal fired packaged boiler having a rated capacity of 3,450 lbs/hour of saturated steam from and at 212 deg. F. (100 H.P.) and 150 psig. working pressure installed at the Fuel

Development Centre of the State Electricity Commission of Victoria. The object of the test was to access the capabilities of the boiler when operated with several bituminous coals of varying characteristics. The boiler was examined for ease of light up, response to load fluctuations, ability to maintain rated load, degree of attention required by the boiler attendant, ability to conform to statutory Clean Air Regulations and operating efficiency. The boiler operated at high efficiency over a range of loads. Correct adjustment resulted in the boiler operating at all times within Clean Air requirements. Response to load fluctuations and ability of the boiler to continuously exceed rated load was better than anticipated. Attention to the boiler during operation was negligible. Manual ash clearing was required, but was not sufficient duration, or frequency, to cause concern. The satisfactory results of testing, when combined with the ease of installation of the fully packaged boiler and its initial competitive cost, indicate that the unit should have a wide application on the Australian market.

09075

John G. Noest, George R. Rich

CORNWALL PUMPED-STORAGE PLANT WILL DO MULTIPLE DUTIES ON CONSOLIDATED EDISON SYSTEM. Power, 107(7):56-59, July 1963.

The Cornwall Project uses the Hudson River as its lower reservoir in the vicinity of famous Storm King Mountain. The plant has eight units with 225-mw nameplate rating and 250-mw capability operating at an average net head of about 1050 ft. A major advantage of the project is its flexibility in the operation of a large interconnected system. The several aspects of flexibility are: (1) economic peak load generation (2) spinning reserve (3) lay-up of older stations and (4) weekend restoration of reservoir level when needed. Another advantage accrues from the high rate of load pickup possible with hydro generators. This characteristic will permit slower load pickup on thermal units, minimizing stack emission which is diccicult to control at high rates of load incease.

09103

Kalishevskii, L. L. and B. G. Ganchev

A STUDY OF THE CYCLONE PROCESS WHEN BURNING SOLID FUEL. Thermal Eng. (English translation of: Teploenergetika), No. 2:70-74, Feb. 1967. 4 refs.

Studies carried out on the MVTU-MoTsKTI cyclone furnace test rig showed that when burning low-ash Donets gas and long flame coals in an axial cyclone chamber losses due to unburnt carbon for the whole plant, in the best conditions, comprised 2-3 percent (there were no losses due to unburnt gases in all cases), when burning the same fuel supplied tangentially losses due to unburnt carbon did not exceed 1 percent. The determination of the combustion efficiency of fuel in the cyclone chamber (over the inner edge of the throat) revealed the same level of combustion efficiency with satisfactory conditions, in both types of chamber. However, the pattern of heat losses differed. The main part of the losses at the outlet of the axial cyclone were due to unburnt carbon (losses due to unburnt gases did not exceed 2 percent) and at the outlet of the tangential cyclone due to unburnt gases (losses due to unburnt carbon were less than 2 percent). The gases in the furnace volume after the cyclone burn better than the non-gasified fuel. Hence the difference in efficiency of the whole plant.

09161

Gronhovd, G. H., R. J. Wagner, and A. J. Wittmaier

COMPARISON OF ASH FOULING TENDENCIES OF HIGH- AND LOW-SODIUM LIGNITE FROM A NORTH DAKOTA MINE. In: Proc. Power Conference 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966, Vol. 28, p. 632-642. 4 refs.

The rate of fouling, as determined both by boiler performance and by probe tests, is much greater when burning lignite having 8 to 10 percent sodium oxide in the ash compared with burning lignite having less than 2 percent sodium oxide in the ash. The tests indicate a remarkably high ash collection efficiency of the boiler tubes on the unit tested. Based on short-time dust loading tests, only 25 and 40 percent of the input ash can be accounted for in the flue gas for the high and low-sodium coals, respectively. Sulfur oxide determinations indicate that the sodium level has a profound effect on the SO2 content of the flue gases. The SO2 increased from about 450 to 850 ppm when changing from high to low-sodium coal. With low-sodium coal, nearly all the coal sulfur can be expected to appear as SO2. Based on the results of these tests, a program designed to supply Hoot Lake Power Station with lignite containing a predetermined level of sodium has been set up. Using two loading shovels at the mine and adjusting the number of trucks serving each shovel, the lignite is blended at the tipple to provide a sodium level determined by the expected electrical load at Hoot Lake. Minor electrical load adjustments can then be made, if necessary, to accomodate the expected lignite blend. Sampling and analysis at the plant have shown a very good correlation with the expected sodium percentages, as predicted by the blending operation at the mine. Plant operating results from the first three months using this procedure look very promising.

09165

Prem, L. L. and T. C. Wang

FLUID METAL AND MHD-STEAM BINARY CYCLE POWER GENERATION. In: Proc. Am. Power Conference, 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966, Vol. 28, p. 282-292. 9 refs.

The fluid metal magnetohydrodynamic power system is a new and promising approach toward achieving an economical topping cycle for central power stations, since it permits raising the temperature by a few hundred degrees. Atomics International's fluid metal MHD concept is reviewed which is in the preliminary stages of its development, and the MHD steam binary cycle is described. The results of the experimental program aiming at demonstrating this concept are presented in some detail. An evaluation of plant economy based upon the proposed binary cycle is also outlined.

09169

Strong, R. E.

ADVANCED DESIGN GAS TURBINES. In: Proc. Am. Power Conference 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966, Volume 28, p. 446-456. 3 refs.

In areas where gas and distillate oil fuels are available as a primary fuel, the gas turbine may be considered for base-load operation in some type of combined cycle plant that utilizes the large quantity of exhaust heat that is available. These plants are started infrequently and operate for long periods of time at relatively constant load. An example of such an application is the industrial utility center that provides heat as well as power to the industrial customer. Another application is the modernization of an existing steam plant with the use of the gas turbine exhaust in the feedwater heating cycle. For the smaller utility, a gas turbine with an exhaust heat boiler generating steam for a helper steam turbine may be desirable. A new gas turbine design which is acceptable for use in electric utility systems is described. The energy in the W-251 turbine exhaust gas can be used either to generate additional power or to satisfy process requirements. The primary objectives of the design have been to attain the increased performance that goes with a higher turbine inlet temperature, provide for fast temperature changes, maintain or improve the life of the hot parts being experienced in the present product line machines, and to further improve reliability. A 200-Mw steam injection gas turbine peaking plant is also described. Specifications have been prepared for a 400 Mw plant which is comprised of two 200 Mw plants. This new development is especially suitable for low capacity factor operations.

09194

Meredith C. Gourdine

ELECTROGASDYNAMICS AND THE COAL INDUSTRY. Preprint. Gourdine Systems, Inc., llp., 1966. (Presented at the National Coal Association Technical-Sales Conference and Bituminous Coal Research, Inc. Annual Meeting, Pittsburgh, Pa., Sept. 14-15, 0966.)

Electrogasdynamics (EGD) is a direct energy conversion technique for converting the pressure energy of a flowing gas directly into high voltage electricity. Positive ions are sprayed on the fly-ash particles in the coal combustion gases by means of a corona discharge. In the generator, these charged dust particles carry the charges downstream, piggy-back fashion, to the collector electrode where they leave the particles and pass through the external load resistance. This current is forced through the load resistance as the gas does work in pushing the charged particles against the opposite electric field in the generator. The gas suffers a pressure drop while doing this work. An EGD compressor is an EGD generator operating in reverse. Instead of extracting electrical power, electrical power is put in the form of an applied electric field and is used to pull the charged dust particles through the gas thereby compressing the gas. The primary advantage of an EGD coal fired station is the fact that it can operate at higher efficiency and can be built at a lower capital cost, thus resulting in cheaper electricity. There are no boilers, no condensers, no forced air fans, and little requirement for cooling water. There is no need for inversion equipment or transformers because the output is high voltage electricity ready for long range transmission. Thus, unlike MHD, the number of major components required is reduced, thereby reducing capital cost.

09353

CLEAN AIR. Roy. Soc. Health J. (London), 86(5):252, Sept.-Oct. 1966.

From the year 1800 to the end of the century the annual consumption of coal in Great Britain rose from about 12 m. tons to 170 m. tons. In 1956, inland comsumption of coal reached a record of 215 m. tons; the amount has since declined and is now about 180 m. tons a year. The quantity of petroleum oils used for fuel and power in Britain in the year 1900 was less than 1 m. tons. By 1956 it had reached 22 m. tons and in 1964 it was 54 m. tons. Public attention was roused to the need greatly to reduce pollution of the air by smoke and fumes from coal by the 'smog' of December, 1952, which in a few days caused an increase of 4,000 deaths above normal for that time of the year in the London area alone. This led to the appointment in 1953 of the Government Committee on Air Pollution and in 1956 to the Clean Air Act. The quantity of smoke discharged into the air of Great Britain has decreased from 2.7 m. tons to 1938 to 2.2 m. tons in 1956 and 1.2 m. tons in 1964. Progress generally by local authorities in establishing smoke control areas has been far too slow. Of the number of premises in the so-called 'black areas' only about 30 per cent are in the regions so far covered by smoke control orders. One problem that has not yet been satisfactorily solved is that of dealing with the increasing discharges of oxides of sulphur from the sulphur in fuels. Research is in progress but at the moment the only practicable palliative is that of discharge of the flue gases from high chimneys to keep down the concentrations near ground level. It is estimated that the quantity of carbon monoxide discharged from petrol-driven vehicles in Great Britain in 1964 was in the region of 5 m. tons. Improved combustion in petrol engines and not the use of after-burners must be the aim and there is no doubt that improved combustion can be achieved.

09482

CONSOLIDATED EDISON COMPANY OF NEW YORK PLANS WORLD-RECORD 1000-MW UNIT FOR ITS RAVENSWOOD GENERATING STATION. Power, 107(6):53- 56, June 1963.

A proposed power plant to be located in Ravenswood, N. Y., is described in detail. The plant is 1000 MW, oil-, coal-, or natural gas-fired. Specifics on the boilers, turbines, combustion control systems, and condensate systems are presented.

09539

Zabroske, Tony A.

BOILER CONVERSION REDUCES COSTS AND AIR POLLUTION. Plant Eng., 22(6):96, 98, March 21, 1968.

The new, converted boilers at the Stewart-Warner Corp. are described. Total cost for the conversion of three 500-hp. water tube boilers from coal to a combination of gas and oil firing was $79,221. A true internal nozzle-mixing type, steam-atomizing oil burner was installed as well as a 50,000-gal. oil tank. Following the conversion, cost of operation has been reduced, the salary of four firemen eliminated, maintenance costs lowered, housekeeping easier, smoke control better, and coal and ash handling eliminated.

09588

Public Health Service, Washington, D. C., Air Pollution Technical Information Center

AIR POLLUTION ASPECTS OF THERMAL POWER PLANTS. (AN ANNOTATED BIB- LIOGRAPHY.) 14p., March 27, 1968.

The bibliography contains abstracts of 27 selected references on the steam plant and air pollution. The oldest reference was originally presented in 1960; the most recent one was published in January 1968.

09686

R. L. Duprey

COMPILATION OF AIR POLLUTANT EMISSION FACTORS. Public Health Service, Durham, N. C., National Center for Air Pollution Control, Publication No. 999-AP-42, 67p., 1968. 126 refs.

Detailed emission factors are given for the following processes and industries: fuel combustion, refuse incineration, chemicals, food and agriculture, metallurgical refining, minerals, petroleum, pulp and paper solvent evaporation and gasoline marketing, and transportation (vehicle emissions).

09737

Ozolins, G., and C. Rehmann

Ozolins, G. and C. Behmann

AIR POLLUTANT EMISSION INVENTORY OF NORTHWEST INDIANA. (A PRELIM- AIR POLLUTANT EMISSION INVENTORY OF NORTHWEST INDIANA. (A PRE- LIMINARY SURVEY, 1966.) Public Health Service, Durham, N. INARY SURVEY, 1966.) Public Health Service, Durham, N. C., National Center for Air Pollution Control, APTD-68-4, 36p., C., National Center for Air Pollution Control, APTD-68-4, 36p., April 1968. April 1968.

Sources of air pollutant emissions were surveyed to quantify the

Sources of air pollutant emissions were surveyed to quantify the total pollution load emitted to the air over the Northwest total pollution load emitted to the air over the Northwest Indiana communities of East Chicago, Gary, Hammond, and Whiting. The Indiana communities of East Chicago, Gary, Hammond, and Whiting. The emissions are reported on an annual basis and sub emissions are reported on an annual basis and subdivided into the five major pollutants: particulates, sulfur oxides, nitrogen divided into the five major pollutants: particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide. The oxides, hydrocarbons, and carbon monoxide. The four major source catagories that were utilized in reporting emissions from area and four major source categories that were utilized in reporting emissions from area and point sources are: fuel combustion in sta- point sources are: fuel combustion in stationary sources, fuel combustion in mobile sources, combustion of refuse, and industrial tionary sources, fuel combustion in mobile sources, combustion of refuse, and industrial process losses. The results of this sur process losses. The results of this survey are reported by city and illustrated on the grid system established by the Northwest vey are reported by city and illustrated on the grid system estab- lished by the Northwest Indiana Air Resource Management Indiana Air Resource Management Program. (Authors' abstract) Program. (Authors' abstract)

09831

Walsh, Robert T.

GASEOUS AND LIQUID FUELS. In: Air Pollution Egineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 507-514, 1967. GPO: 806-614-30

The burning of gaseous and liquid fuels is so commonplace that it enters directly into a vast number of air-polluting processes. The burning of any fuel under less than optimum conditions produces some quantities of carbon, ash, and unburned and partially burned hydrocarbons. In addition, many fuels contain sulfur and metallic compounds that are, even in the oxidized state, air pollutants. Air contaminants generated from fuel burning fall into three categories: (1) Carbon and the unburned and partially oxidized organic materials that result from incomplete combustion, (2) sulfur oxides and ash directly attributable to fuel composition, and (3) oxides of nitrogen formed at firebox temperatures from oxygen and nitrogen of the air. Incomplete combustion products can usually be held to tolerable minimums with proper operation of modern burner equipment. Sulfur and ash emissions are governed by the fuel makeup. Nitrogen. Nitrogen oxide concentrations are primarily functions of firebox design and temperature. The causes of such phenomena as black smoke, white smoke, sulfur and nitrogen oxides, and particulate emissions are discussed. Compositions of common fuel gases, fuel oils, and their combustion products (both gaseous and solid) are tabulated. Sulfur removal from fuels and municipal regulations limiting sulfur compound emission and sulfur content in fuels are discussed. Combustion products of any given fuel may be determined by the method illustrated.

09989

Risser, Hubert E.

THE DRIVE FOR CLEAN AIR AND ITS EFFECT ON RELATIVE RESERVES AND AVAILABILITY OF LOW SULFUR METALLURGICAL COKING COALS--PANEL DIS- CUSSION. (PART IV.) Kinzoku (Metals) (Tokyo), 20(4):71-72, April 1968.

A very brief discussion of the sulfur content and resources of coal in Illinois is presented. The costs of utility and coking coal in the area are mentioned.

10183

Weaver, Robert D.

FEASIBILITY STUDIES OF THE ELECTROTHERMALLY REGENERATIVE TRANSDUCER. GeneralMotors Corp., Anderson, Ind., Delco- Remy Div., Contract DA 33-008-ORD-2335, Proj. 518-01-001, 143 p., March 30, 1963. 238 refs. DDC: AD 403290

A new method of converting thermal energy to electricity has been investigated and the results are presented in this final report under the contract. The method employs electrochemical principle and the device has been [illegible] by Electrothermally Regenerative Transducer. The possible advantafe of this Transducer have been evaluated by estimating the weight and efficiency of systems designed to meet new requirements of interest to the Army Tank and Automotive Center. Results of laboratory work, performed to check the theoretical principles of operation, are included. The study has shown a limiting efficiency of 35% conversion of heat. A Transducer system capable of providing 500 ampers continuously at 28 volts, with a maximum current of 500 ampers at 18 volts, has been designed. The average efficiency calculated for design is 24% and the weight is 8ll pounds. Laboratory data obtained on single electrodes show current densities of more than 25 amperes per square inch to be possible. It is concluded that further study of this system is warranted because of its efficiency, simplicity, silence of operation, and its specific power. Continuation of work directed at obtaining ope-ating cells is recommended. (Author s abstract)

10284

Frankenberg, T. T.

HIGH STACKS FOR THE DIFFUSION OF SULFUR DIOXIDE AND OTHER GASES EMITTED BY ELECTRIC POWER PLANTS. Am. Ind. Hyg. Assoc. J., 29(2):181-185, March-April 1968. 6 refs.

Experience with the satisfactory dispersion of hot gases from two power plants each larger than 1000 MW designed in 1952-1953 is detailed. The effects of this experience on the design of 825-foot stacks for the Cardinal Plant is covered, with a description of test work underway to verify the results. This includes dustfall and sulfur dioxide sampling at fixed locations. A case is made for the use of high stacks to control ground level concentrations, rather than resorting to fuel restrictions or emission standards which are unnecessary and economically unsound. (Author's abstract, modified)

10424

Graham J. Cleary

THE CONTRIBUTION OF DIFFERENT SOURCES TO POLLUTION BY POLYCYCLIC AROMATIC HYDROCARBONS. Clean Air (J. Clean Air Soc. Australia New Zealand) 2(1):13-17, March 1968. 40 refs.

The contribution from automobile exhausts, coal combustion sources, products from the combustion of gaseous and liquid fuels, tire rubber, and incinerator effluents to atmospheric pollution by polycyclic hydrocarbons is examined briefly. Concentration ratios for the compounds 3,4 benzopyrene/1,12 benzoperylene and for 3,4 benzopyrene/coronene are used to examine the mode of pollution is Sydney and to compare this pattern with other cities in Great Britain and the United States of America. (Author's abstract)

10442

FUELS: ENERGY DEMANDS. WORLD FUEL RESOURCES. PREPARING FUEL FOR MARKET. PUTTING FUELS TO WORK. POLLUTION'S CHALLENGE. FUEL'S NEW ECONOMICS. (SPECIAL REPORT.) Power, 112(6):S1-S48, June 1968.

With fuels so fundamental to our very existence, a broad yet detailed look is taken at present technology, starting with an evaluation of energy demands, then on through the many steps leading to the application of these fuels. All fuels are considered coal, gas, oil, nuclear. In a section titled 'Pollution's Challenge', the problems related directly to pollution control are reviewed. The combustion of fuel creates the largest single class of air pollutants; it runs the gamut from boiler flue gas to automobile exhaust. In nuclear power plants constant vigilance must be exercised to avoid potential radioactive contamination. Desulfurization of fossil fuels, treatment of flue gas, application of additives to the fuel or by injection to the combustion zone, methods which have a place in the practical scheme of pollution control.

10444

Ratcliffe, D. B. and A. T. S. Cunningham

THE SEMI-MICRO DETERMINATION OF TOTAL SULPHUR IN COAL BY THE OXYGEN FLASK METHOD. Fuel, 47(2):89-92, Mar. 1968. 4 refs.

This paper presents evidence placed before B. S. I. Committee SFE 45/8 'Analysis and Testing of Coal and Coke' in the course of its revision of B.S.S. 1016 Part 6-Ultimate Analysis of Coal: Total Sulphur. It is shown that the oxygen flask tech nique is suitable for the routine analysis of small samples of coal. It is also shown that while the precision now obtainable using this method is adequate for most routine uses, it does not quite justify the method being included in the Standard with the Eschka and high temperature methods, as a referee technique. (Authors' abstract)

10678

Bachl, Herbert

DISTRICT HEATING, WASTE INCINERATION AND ELECTRIC NIGHT-TARIFF HEATING, AND AIR POLLUTION CONTROL IN MUNICH. Staub (English translation), 28(2):17-31, Feb. 1968. CFSTI: TT 68-50448/2

As a result of special meteorological conditions, inversions fre- quently occur in Munich. First, the results of immission measurements are reported, which were carried out in different town regions, and then the preventive measures introduced are ex plained. The influence of different types of fuel and of various heights of chimneys on SO2 emissions is discussed. The develop ment of long distance heat supply and of electric heating is com bined with direct burning of natural gas. The power plant which is situated in the town and comprises installations for long dis tance heat supply and for refuse incineration has proved to be highly expedient. Coal is preferably used as the additional fuel in the power plants situated at town outskirts, whilst natural gas is used in the power plants situated in the town centre. 10688 Bachl, Herbert DISTRICT HEATING, WASTE INCINERATION AND ELECTRIC NIGHT-TARIFF HEATING, AND AIR POLLUTION CONTROL IN MUNICH. Staub (English translation), 28) 2-:18-31, Feb. 1968. CFSTI: TT 68-50448/2 EMISSION SOURCES: Domestic heating, Power production, Incinerators As a result of special meteorological conditions, inversions frequently occur in 7unich. First, the results of immission measurements are reported, which were carried out in different town regions, and then the preventive measures introduced are explained. The influence of different types of fuel and of various heights of chimneys on SO2 emissions is discussed. The development of long distance heat supply and of electric heating is combined with direct burning of natural gas. The power plant which is situated in the town and comprises installations for long distance heat supply and for refuse incineration has proved to be highly expedient. Coal is preferably used as the additional fuel in the power plants situated at town outskirts, whilst natural gas is used in the power plants situated in the town centre.

10740

Calhoun, F. P.

AVOIDING POLLUTION FROM REFUSE DISPOSAL. Mining Congr. J., 54(6):78-80, June 1968.

The burning refuse pile has been a large contributor to the unfavorable image of the coal industry. Following a few fundamental rules in building the refuse pile can keep the pile from causing a pollution problem as well as from becoming an eyesore after it is abandoned. Clearance of all vegetation from the area, construction of drainage ditches, control of the size consist to make packing easy, adequate layering of the refuse, and control of the slope are all factors to be considered in the formation of the refuse pile.

10743

Christie, John

THE PROBLEMS OF SMOKE CONTROL. Smokeless Air, 38(146):257-262, Summer 1968.

The problem of smoke control are found in both domestic and industrial furnaces. The household open type fire when burning bituminous coal can produce a considerable amount of smoke and since discharge into the atmosphere is at a low level the pollution problem is aggravated. It is the job of the local authorities in Great Britain to deal with smoke control violations. The problems of industrial control are more complex because of the great variation in the industrial plants under consideration. However smoke attributed to industrial plants has been reduced by 50% since 1960. Important factors in this improvement are the recognition of the relationship of smoke emission to inefficient use of fuel.

10754

Jaffe, Louis S.

AMBIENT CARBON MONOXIDE AND ITS FATE IN THE ATMOSPHERE. J. Air Pollution Control Assoc., 18(8):534-540, August 1968.

Carbon monoxide, the most abundant air pollutant found in the atmosphere generally exceeds that of all other pollutants combined (excluding CO2). An estimated tonnage of more than 87 x 1,000,000 of CO was emitted in the United States from major technological sources alone during 1966. More than 90% of the total CO emitted from fossil fuels is derived from gasoline powered motor vehicles. Other sources of CO include emissions from coal and fuel oil burning, aircraft and open burning. Some CO is also formed by certain vegetation and marine invertebrates (siphonophores). Chemical reactions of CO in the upper and lower atmosphere are discussed. Chemical oxidation of CO in the lower atmosphere by molecular oxygen is very slow. The exact duration of CO in the lower atmosphere is not known with certainty; however, the mean residence time has been variously estimated to be between 0.3 and 5.0 years. In the absence of scavenging processes the estimated world-wide CO emission would be sufficient to raise the atmospheric level by 0.03 ppm per year, yet the background levels of CO in clean air do not appear to be increasing. Several potential sinks are discussed. Knowledge of the mechanism of process of removal of CO from the lower atmosphere is unsatisfactory; the process, at the present time, cannot be identified with certainty. (Author's abstract)

11411T

M. Andritzky

GARBAGE POWER PLANT MUNICH. (Mullkraftwerk Munchen.) Translated from German. Brennstoff-Waerme-Kraft (Duesseldorf) 14(5):232-233, 1962.

The refuse power plant in Munich is described and the seasonal changes of the garbage collected (composition and heating value shown in graphs) are described in comparison to those in Antwerp, Rotterdam and Vienna. The power plant burns approximately 60% coal dust and 40% garbage in separate combustion rooms of a common high-pressure steam generator. The first version of the plant has a capacity of 68 million watts and supplies steam for a long-distance heating system. After the second construction phase and a capacity of 100 million watts, all garbage collected in the city of Munich can be burned in this plant. The installation is shown in a diagram. Purification of the flue gas is emphasized. An electro filter providing 99.75% dust removal is mentioned, and the pneumatic transport of flue ash from the boiler to a collecting bunker is described. The proximity of an airport limited the height of the smokestack to 80 meters.

11413T

H.F. Kammerer

WASTE INCINERATION PLANT WITH HEAT UTILIZATION IN STUTTGART. (Mullverbrennungsanlage mit Heizwaermeverwertung in Stuttgart.) Translated from German. Brennstoff-Waerme-Kraft, 14(10):476-478, 1967. 2 refs.

The development of the waste incineration plant with heat utilization in Stuttgart Germany, is discussed briefly and the essential elements of the plant are described. It incorporates the knowledge gained from existing refuse power plants and experimental plants adapted to local conditions. The power plant burns heavy fuel oil and refuse in separate combustion chambers of a common steam generator. Electrofilters with a 98 percent degree of separation are planned for removal of dust. The heat produced is fed into the city heat supply via the steam collecting lines of the power plant. The heat utilization system is illustrated and discussed. A steam generation of approximately 30 tons/hr per refuse furnace is expected. Economic aspects, including capital cost, are briefly mentioned.

11502

Gerstle, R. W.

ESTIMATING PARTICULATE AND SULFUR DIOXIDE EMISSIONS FROM FUEL COMBUSTION. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 12p., Aug. 1968. 4 refs.

A discussion of how to estimate particulate and sulfur dioxide emissions from fuel-burning processes is presented. Emphasis is placed on applying correction factors to these emission values in order to relate them to the various conditions specified in regulations that apply to these emissions. (Author's abstract)

11619

Auckland Air Pollution Research Committee, New Zealand

NINTH ANNUAL REPORT OF THE AUCKLAND AIR POLLUTION RESEARCH COMMITTEE FOR YEAR ENDING 31 MARCH 1968. 72p., 1968. 27 refs.

Data are presented pertaining to the pattern of fuel use, future sources of electrical energy, and meteorological conditions in the Auckland area. The relative importance of the different fuels used for domestic, commercial, industrial, and transportation purposes i considered, and an attempt is made to evaluate the probable rates of emission from their combustion. Seasonal and regional variations in the use of fuels are noted. In the case of domestic fuels, there are also daily variations. Maximum emissions of smoke and other pollutants from domestic sources occur during the early morning and late afternoon. These emissions often coincide with periods of little or no air movement. However, the use of coal, wood, coke, and briquettes is declining in the Auckland area and more reliance is being placed on cleaner methods of heating, such as electric heating appliances and oil-fired central heating units. Upward trends in the production of sulfur dioxide and nitrogen oxides may be offset to some extent by increasing electricity consumption. Sulfur dioxide levels could be reduced by fuel desulfurization processes. Another factor affecting Auckland's air pollution is the advent of natural gas. Increased usage of this fuel will assist in reducing levels of all pollutants.

11637T

Andritzky, M.

SECOND EXTENSION OF THE REFUSE POWER PLANT IN MUNICH. ((Zweiter Ausbau des Mullkraftwerks Munchen.)) Translated from German. Brennstoff-Waerme-Kraft, 16(8):403, Aug. 1964.

The differences between the design of the second stage of the refuse power plant in Munich and the first stage are outlined. The refuse firing in the first construction stage was designed so that approximately 40 percent of the steam output is obtained from refuse, in the second stage the contribution of the refuse is only 20 percent. Instead of the two originally planned steam generators with approximately 32 tons per hour refuse throughput each, there will only be one with a throughput of 40 tons per hour. The third factor in which the second stage differs from the first one is that there is no separation in the former between the combustion chamber for refuse and powdered coal.

11640T

Bachl, Herbert and Franz Maikranz

INCINERATION OF REFUSE IN A HIGH-PRESSURE STEAM PLANT. ((Erfahrungen mit der Verfeuerung von Mull in einem Hochdruck- Dampfkraftwerk.)) Translated from German. Energie, 17(8):317-326, Aug. 1965.

Refuse is used as a fuel in two high-pressure superheated steam boilers at the 'Nord' power station of the Munich municipal system. The boilers are designed for burning coal or refuse, either alone or in combination. The technical features of the plant are given in detail, including the site-map of the station, boiler design data, construction history 1961-65, firing mechanism, and experience in operation. The design and operation of a refuse shed and crane are discussed, and experimental runs with coal and refuse firing are described. Refuse averaged 45-50% of ash and was found to contain only 1.64-2.48% of scrap metal. The storage bin and loading area did not attract rats or vermin. Refuse feeds of 25 tons/hr were achieved with a caloric output of 1200-1300 kcal/kg. The percentage of refuse in the overall operation will be about 35%. The refuse-generated power would have negative prices due to the city subsidies. The financial advantages would benefit the city administration and the government. Refuse combustion will supply about 10% of the total future power requirement of Munich. Air pollution is not discussed, except indirectly, in terms of the high combustion efficiency of the coal burned, and the presence of an electrostate precipitator in the system.

11655T

C. Kachulle

REFUSE INCINERATING PLANTS WITH OR WITHOUT HEAT UTILIZATION. A MAIN SUBJECT OF THE THIRD CONFERENCE OF THE INTERNATIONAL WORKING GROUP FOR REFUSE RESEARCH, TRIENT, 1965. ((Abfallverbrennungsanlagen mit oder ohne Warmenutzung. Ein Hauptthema des dritten Kongresses der Internationalen Arbeitsgemeinschaft fur Mullforschung in Trient, 1965.)) Translated from German. Brennstoff-Waerme-Kraft, 17(8):391-395, Aug. 1965

Several refuse research topics were discussed, including refuse incineration with heat utilization for steam generation. A cost comparison of a refuse incineration plant in Issy-les Moulineux which has four furnaces with a capacity of 17 tons/hr each, showed that income from the sale of electric power and steam exceeds the operating expense. In Glasgow, Scotland, it was found that the electricity generated in refuse combustion cannot be sold in Great Britain on a continuous basis. Another topic discussed was a central refuse disposal plant installed as additional incineration units in existing power plants. Such an installation is being operated in Goldenberg., near Cologne, Germany. The operating capacity of this unit is 1,026,000 tons/year. The planning and design for the Goldenberg plant are illustrated and discussed in detail, including refuse transportation from a wide area on compactor trucks with removable bodies, rubbish and scrap processing, moving grate incineration, and refuse storage in surrounding mines. The advantages of large central incineration plants are discussed. No air pollution control details are given.

11739

Ritchings, F. A.

RAW ENERGY SOURCES FOR ELECTRIC GENERATION. IEEE (Inst. Elec. Electron, Engrs) Spectrum, 5(8):34-45, Aug. 1968.

Air pollution is one of several factors taken into consideration in this forecast of the electrical energy picture in the USA through 1985. Other factors include economics, fuel availability, relative plant size, and transportation costs. It is predicted that the consumption of all forms of raw energy for electric power generation will increase substantially during the next 15 years, probably at 3 times the rate of total energy consumption (3.1--4.5%/yr.). By 1985, nuclear energy will provide more than 40% of the electric power produced in the USA, and probably more than 70% of that produced in New England. Of the 4 major sources of energy currently exploited for electric power generation: coal, gas, water, and oil (nuclear energy accounted for only 0.4% of the total output in 1965), coal is the only one for which the resources are almost unlimited (900 yr. at present rate of consumption). However, under the Air Quality Act of 1968, coal or oil-fired generating units 'will either have to burn the higher-cost, low-sulfur fuels or provide some means of reducing the SO2 content of stack gases.......' '.....the simpler SO2 removal systems, without provision for sulfur product recovery, may require an investment of $7 to $8 per kilowatt and result in an owning and operating cost equivalent to a fuel cost of 3 to 4 cents/MBtu. This will further accelerate the trend to nuclear energy sources in the traditionally coal and oil-burning areas.'

11789

Federal Power Commission, Washington, D. C., Bureau of Natural Gas

PRESENT AND FUTURE USE AND AVAILABILITY OF NATURAL GAS IN THE MINNEAPOLIS/ST. PAUL AREA. 24p., Feb. 1969.

The area which the Dept. of Health, Education, and Welfare proposes to designate as the Air Quality Control Region (AQCR) consists of the two cities Minneapolis/St. Paul and ten adjacent counties. The area is supplied with natural gas by one interstate transmission company, and the gas is distributed by two major distribution companies. Four smaller distribution companies and one small municipal system also serve the area with gas purchased from the transmission company. Virtually all of these distribution companies have plants to manufacture propane-air gas which is mixed with natural gas during periods of peak demand. The transmission company also sells gas directly to several industrial plants in the area. These companies, along with the sales volumes, revenues, and rates are given in a table. Operating statistics are given for five plants. Four of the plants are major generating stations. The commercial and industrial gas consumption, namely, sales by companies and gas used in its generating plants for the five years 1963-1967 in the area, are tabulated. The data indicate that the gas consumption has been increasing by about four percent/yr and that the average gas prices during the period were fairly stable. A comparison of fuel prices submitted by the area gas distributors is given.

11790

Jimeson, Robert M. and James M. Grout

SOLVENT REFINED COAL: ITS MERITS AND MARKET POTENTIAL. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y., 22p., 1969. 7 refs. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Washington, D. C., Feb. 16-20, 1969.)

The potential market for solvent refined coal is estimated to be between 17-28 million tons, with the market sufficiently scattered to support processing plants in at least four coal regions in the United States. Assuming an increasing demand for low-sulfur fuels, the potential market is expected to increase 40% in the next ten years. Solvent refined coal is the product of a process which dissolves raw coal in a solvent, separates the ash from the coal by filtration, and reconstitutes the coal from the solvent. The reconstituted coal is free of water, low in sulfur, very low in ash, and sufficiently low in melting point that it can be handled as a fluid. In its solid state, the product is brittle and readily grindable into a fine powder. Markets are possible in combustion, railroad locomotion, and carbon electrodes. The combustion characteristics of solvent refined coal are consistent with expected air pollution restrictions on the emission of sulfur and particulate matter.

11860

Schaffer, S. G. and R. W. Noble

TECHNIQUES FOR THE UTILIZATION OF FLY ASH. Am. Chem. Soc. Div. Fuel Chem. Preprints, 10(1):73-80, 1966. (Presented at the American Chemical Society Division of Fuel Chemistry Symposium on Fossil Fuels and Environmental Pollution, joint with the Division of Water, Air, and Waste Chemistry, Pittsburgh, Pa., March 22-23, 1966.

Fly ash has been utilized with limited success as filling material for asphalt roadways and as a substitute for cement in the production of concrete. Roads with asphalt filling performed well, but this method of utilization would not nearly approach the total amount of fly ash produced each year by the electric industry. Bulk concrete and concrete blocks with fly ash additives in quantities up to 25-30% show good compressive strength, and this method of utilization would provide a market for all fly ash produced. However, several factors limited the marketing of fly ash on so large a scale. Among them are variations in the properties of fly ash from location to location and time to time; the possibility of staining due to the presence of iron; transportation costs; and problems of storage. To date, the most promising method for utilizing fly ash appears to be as a lightweight aggregate. When sintered and crushed, the product can be used as a substitute for fine or coarse aggregate in concrete, concrete block, roadways, and wherever aggregates are required. The advantage of sintered fly ash aggregate is its weight. When sized to concrete block grade, sintered fly ash weighs 48-50 lbs/cu ft. Such a reduction in block weight can mean a decrease in building structure, handling, and shipping costs. Concrete and concrete block using fly ash aggregate greatly exceed minimum strength requirements.

11968

Bachl, Herbert and Franz Maikranz

FIRING REFUSE IN A HIGH-PRESSURE STEAM PLANT. (Erfahrungen mit der Verfeuerung von Muell in einem Hochdruck-Dampfkraftwerk). Energie (Munich), 17(8):317-326, 1965. Translated from German. 26p.

The problem of refuse incineration and refuse utilization was solved in a new way in the Nord power station of the Munich municipal power system. Refuse is used as a fully equivalent fuel in two high-pressure superheated steam boilers. The boilers are designed for firing coal and refuse alone or in combination. When coal and refuse are combined, 60% of the full-load heat is supplied by coal and 40% by refuse. When only refuse is fired, reduced steam pressures and steam temperatures are used without generation of electricity. The installation can also be converted to gas firing or oil firing. In the pulverized coal-firing boilers, refuse is burned on Martin refuse grates located under the refuse flue gas pass. At full load, a boiler efficiency 92.5% is guaranteed for all-coal firing; efficiency for combined operations is 85%. The annual capacity of the boilers is expected to be about 420,000 t/yr of refuse. At an average refuse heating value of about 1200 kcal/kg, about 500,000 Gcal/hr is supplied the power station by refuse. In coming years, the plant is expected to meet about 10% of Munich's power requirements. The boilers and auxiliary plant equipment are described in detail.

11981

Hradecky, Frantisek

METHOD OF FLY-ASH HANDLING IN LARGE POWER PLANTS, TRANSPORTATION OF THE ASH TO THE DUMPS AND INTO OPENCAST MINES AND PITS. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 61-70.

In general, hydraulic transportation is employed in Czechoslovakia for the disposal of ash and slag from thermal power plants. The materials are hydraulically transported to an excavator station and from there, by dredge pumps, to a dump. The method is reliable, but the dumps are a source of environmental contamination. Other possibilities of ash storage are represented by waste banks and mine pits. Tranportation to the pits by means of dust-free rubber bolts would be suitable, but the technology is not sufficiently developed. For distances to 10 km, pneumatic transportation seems the most advantageous, although the present equipment does not meet required technical standards. Problems to be solved involve the draw-off of fly ash from individual spoil banks to auxiliary collectors, the transportation of the ash to dispatching silos, and the problem of transporting slag in pneumatic fly ash destined for mines. In the mines, a part of the fly ash would be used for filling and for decontamination purposes; the rest would be added to waste banks. Theoretical calculations indicate that total power plant ash production could be stored in pits and waste banks. This solution would bring about better land utilization, reduce the cost of storing waste materials, and improve the appearance of the country.

11982

Dousa, Karel

THE EFFECT OF HYDRAULIC FLY-ASH HANDLING ON LIVING. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 71-82.

Slag and fly ash are usually conveyed to an excavator tank from which they are flushed by sluice water through pumps and pipelines to dumping areas in the hydraulic method of handling fly ash produced by the combustion of solid fuels. The stored slag-fly ash material endangers human health by creating excessive dust, affecting the physical-chemical properties of surface and underground water, and introducing noxious elements to the air. Crops, animals, and the forest economy are similarly affected. These negative effects are partly attributed to the composition of the waste water and water levels inadequate to secure the necessary sedimentation of the slag-fly ash mixture. Sedimentation and aspiration methods are proposed to reduce the dust nuisance caused by the dumps along with modifications in the distribution of transport waters and their mixtures.

11988

Cmarko, Vojtech and Vladislav Kapalin

OCCURRENCE OF ARSENIC EXHALATIONS IN THE COMBUSTION OF YOUNGER COAL. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 159-170.

The average arsenic values for Czechoslovak coal are 655-875 g/t coal. In contrast, the arsenic content of the Novaky coal burned by a power plant near Zemianske Kostol is 1.166-1.343 g/t coal. The majority of the arsenic compounds are bound to fly ash, 20% of which escapes to the atmosphere. The remainder of the fly ash is absorbed by electrostatic precipitators. The maximum measured concenstration of arsenic in the atmosphere around the plant is 0.069 mg/cu m. One km to the south of the plant, arsenic values in surface soil are 163-372 kg/soil. Arsenic concentrations in well water are 0.023-1.11 per one l of water. Plant bacteria in the soil have decreased, while the percentage of sporulating microbes has increased. The average arsenic content in river water is 0.023 mg/l; in periods of drought, it increases as much as 10 times. Significant differences are noted in the hemoglobin levels in children in the area as compared to the Slovak average. Acute respiratory disease and pyodermias are frequent among workers in the region.

12088

CHEMICAL POWER PLANTS. NUCLEAR OR CONVENTIONAL? Chem. Eng., 75(26):66-68, Dec. 2, 1968.

Alone or in partnership, chemical companies in West Germany are turning to nuclear power for more economical electricity and steam. Most large chemical complexes are huge consumers of steam and power on a fairly continuous basis. This makes them ideal partners for the improved economics of nuclear generation. In 1967, the total power consumption of the German chemical industry was 34 billion kwh, of which 46% was produced by the industry itself. This explains the chemical industry's interest in keeping power costs to a minimum. The high cost of power generation with coal due to government controls is another powerful force in the direction of use of nuclear power.

12120

Duzy, A. F.

AMERICAN COAL CHARACTERISTICS AND THEIR EFFECTS ON THE DESIGN OF STEAM GENERATING UNITS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1959. 13 refs. (Presented at the American Society of Mechanical Engineers, Annual Meeting, Atlantic City, N. J., Nov. 29-Dec. 4, 1959, Paper 59-A242.)

Important coal characteristics are considered with respect to the design of steam generators, including the major components from the coal bunker outlet through fuel equipment, furnace, convection sections, air heaters, and dust collectors. Size content, moisture content, volatile-matter content, calorific value, ash content, and ash-fusion temperature are discussed, together with sulfur content, size distribution, and grindability. Theoretical air requirements are determined for stoker-fired boilers, boilers fired by pulverized coal, and furnace cyclones. Consideration is also given to the deteriorating quality of coal with respect to quantity and characteristics of the ash. The unavailability of cleaner steaming coals will necessitate improvements in metals, methods of controlling obnoxious flue-gas constituents, methods of ash disposal, and steam-generator design.

12202

Gluskoter, Harold J. and Jack A. Simon

SULFUR IN ILLINOIS COALS. Illinois State Geol. Surv. Circ. 432, 28p., 1968. 29 refs.

The occurrence and distribution of sulfur in Illinois coals was described. Sulfur is present within coal as sulfide, as sulfate, and in organic combination. Sulfide sulfur occurs primarily as pyrite. Sulfate sulfur is usually of little significance, except in weathered coals where ferric and ferrous sulfates may be of importance. There is a wide range of both pyritic and organic sulfur in face-channel samples of coal, although the range is less for organic sulfur than pyritic sulfur. Generally, there is a positive correlation between pyritic and organic sulfur in these samples. The pyritic sulfur is usually greater in the fusain bands than in the clarain and vitrain bands. The organic to pyritic sulfur ratios are higher for both vitrain and clarain, with clarain being the richest in organic sulfur. Three areas of relatively low-sulfur coal are sufficiently well known to be outlined and mapped. These are an area of Herrin Coal in south central Illinois, an area of Herrin Coal in southwestern Illinois, and an area of Harrisburg Coal in southeastern Illinois. The organic sulfur content is more uniform throughout a vertical section of a coal seam than is the pyritic sulfur content. Large vertical variations in pyritic sulfur were commonly observed. When the mineral bands in excess of three-eighths thick were disregarded, there was a tendency for pyrite, and therefore total sulfur content, to be greater in the top and/or bottom benches of the coal seam. (Author abstract modified)

12266

Steinberg, M., J. Powell, M. Beller, and B. Manowitz

HYBRID FOSSIL-NUCLEAR FUELED MHD POWER CYCLES. Brookhaven National Lab., Upton, N. Y., 15p., June 1968. 1 ref. CFSTI: BNL 12569

The H2-O2, the CO-O2, and the CO + H2-air systems are described and the advantages and disadvantages enumerated. With the H2-O2 system, coal is reformed entirely to hydrogen using the gasifying and shift reactions. The ash, hydrogen sulfide, and carbon dioxide are removed, and the resulting hydrogen is burned in the MHD with oxygen from an air separation plant. Water is added to the combustor as a diluent for temperature control. It is a fully condensing system, Cs removal is simpler, and the MHD generator is small. But large reforming and oxygen plants are needed. A high temperature heat transfer material is required in the gasifier. With the CO-O2 system, coal is gasified with recycled CO2 to form CO. the ash and H2S are removed, and the clean CO is burned with O2 from an air separation plant. Additional CO2 recovered from the exhaust gases is added to the gasifier and combustion to act as a diluent for temperature control. The highest efficiency, potentially 74% or higher, can be obtained in this system. The reforming investment is reduced. A more efficient MHD generator can be used. Recovery and recycling of the CO2 is a disadvantage. The cycle is non condensing. With the CO + H2 -air system, coal is reformed by partial oxidation with steam to CO and H2. The oxygen for the reformer is obtained from an air separation plant. The ash and H2S is removed and the clean CO and H2 is burned in the combustor using compressed preheated CO air. Nitrogen is used as diluent. The advantages are that the plant size is reduced by a factor of 4 and the reforming investment is reduced because there is no shift reaction. The need for operating with a balanced or slightly reducing flame in the combustion gases fed to the MHD to minimize formation of nitrogen oxides is a disadvantage.

12285

Ernst and Ernst, Washington, D. C.

THE FUEL OF FIFTY CITIES. NAPCA Contract PH 86-68-37, 95p., Nov. 1968. 12 refs.

The detailed results of a survey of coal, oil, and gas prices and sulfur content in 50 U. S. metropolitan areas are presented.

The survey was taken from March to June 1968 by telephone, and results are estimates of various grades of fuels correlated with sulfur and ash content; prices are shown in dollars per million British Thermal Units. Prices vary with the quantity purchased. Four classes of users are defined in terms of the quantities of each type of fuel consumed: domestic, commercial, and industrial users and power plants. A methodology is presented for calculating the order-of-magnitude costs of reducing sulfur oxide and particulate emissions by changing fuels in a specific stationary combustion source. Two types of fuel changes are considered: fuel substitution and fuel switching. This method permits the costs of air pollution abatement by fuel change to be estimated rapidly for the 50 cities of the survey.

12335

Niemeyer, L. E. and F. A. Schiermeier

THE TALL STACK: A QUESTION OF EFFECTIVENESS IN AIR POLLUTION MANAGEMENT. Preprint, National Air Pollution Control Administration, Cincinnati, Ohio, Air Resources Lab., 15p., Nov. 1968.

Studies are being conducted at power plants in western Pennsylvania to define the meteorological conditions under which the effluents from a tall stack are brought to the ground, their frequency of occurrence, the magnitude of the resulting ground-level concentrations, and the effects of the emissions on the agricultural economy of the area. In the meteorological portion of the study, plume rise measurements up to at least 16 km from a stack will be made with a Lidar system consisting of a neodymium laser. To determine sulfur concentrations in a plume, an instrumented helicopter will be flown through a plume in horizontal and vertical traverses at 1 to 5 km from a plant. Measurements of plume dispersion statistics, ground-level sulfur dioxide concentrations, and aereal extent of surface 'fumigations' will be obtained with another instrumented helicopter and portable ground-sampling devices. The procedure is to take a temperature 'sounding' from the surface to 1000 meters or ot an elevation above plume level. Other specialized atmospheric measurements will be made to document the ambient meteorological conditions during an experiment. At selected agricultural sites, the effect of oxidants, sulfur dioxide, nitroge dioxide, and sulfate on plant yield and growth will be determined. The data will be evaluated with reference to the air quality measurements taken at the site and in terms of distance from the power plants.

12541

Perry, H., J. McGee, and D. Strimbeck

ELECTRICITY FROM COAL. THE CYCLES. PART 2. Mech. Eng., 90(12):44-47, Dec. 1968.

Supercharged boiler combined-cycle plants can be operated in various ways with differing problems of cooling water and dust collection. Operation with all power generated by the steam plant with the gas turbine generating only enough power to drive the supercharging compressor would take place at a turbine inlet temperature of 800 deg. F, a temperature that permits the use of an electrostatic precipitator and SO2-removal equipment. On the other hand, operation of this cycle so that 15 to 20% of the plant output is from the turbine, would raise the inlet temperature to 1500 to 1600 deg. F making it necessary to find other means of dust and SO2 removal. One of the proposed methods would be the use of a two-state combustion cycle. A closed cycle gas turbine which shows promise as a topping unit for the steam cycle is also discussed. An engineering and cost study is needed to evaluate the merits of the combined system.

12576

Blade, O. C.

BURNER FUEL OILS, 1968. Bureau of Mines, Bartlesville, Okla. Petroleum Products Survey No. 56., 37 pp., Sept. 1968.

The importance of fuel oils has resulted in the need for more information by the petroleum industry, manufacturers of heating appliances, and consumers regarding the types and qualities of the fuels currently being marketed. In this survey, data on a total of 344 samples of burner-fuel oil are presented. The fuels were manufactured by 34 petroleum refining companies, large and small, in 107 refineries throughout the United States. Summaries of the results of the tests by grades and by regions, compared with data for 1967, are presented in tabular form.

12619

Bartok, W., A. R. Crawford, H. J. Hall, E. H. Manny, and A. Skopp

SYSTEMS STUDY OF NITROGEN OXIDE CONTROL METHODS FOR STATIONARY SOURCES. Esso Research and Engineering Co., Linden, N. J., Government Research Lab., Contract PH-22-68-55, Rept. GR-1-NOS-69, 81p., May 1, 1969. 542 refs.

An interim report on a systems study of nitrogen oxide control methods for stationary sources is presented. The nature and magnitude of the stationary NOX problem in the U. S. is defined, and existing and potential control techniques are identified. A comprehensive, selective review of the pertinent literature, resulting in over 600 items of specific interest was conducted. A detailed questionnaire for steam-electric plants selected on the basis of geographic location and fuel type was developed. Nitrogen oxide emissions from combustion sources are estimated by major sectors (including transportation) and fuel type, for the years 1950, 1955, 1960, 1965, 1970, 1975, 1980 and 2000. Stationary sources account for about 55% and transportation for 45% of uncontrolled emissions for the period 1950 through 1980. The contribution of power generation to the NOX emissions from stationary sources is estimated to increase from 45% in 1965 to 57% in 1980 and 64% in the year 2000. Studies of NOX control techniques have concentrated so far on the identification of promising methods. Several new approaches are identified with potential for simultaneous removal of sulfur and nitrogen oxides. In broad categories, decomposition, reduction, sorption and oxidation techniques are studied. Selective NOX reduction techniques with ammonia or possibly with hydrogen sulfide, aqueous caustic scrubbing techniques, a modified version of the lead chamber acid process, and adsorption on some metal oxides appear to be promising. Known catalysts lack sufficient activity for catalytic NOX decomposition. Combustion process modification techniques are potentially the simplest and least costly approaches to the NOX control problem. However, demonstrated technology is quite limited at present. Low excess air combustion, flue gas recirculation, two-state combustion, burner location and spacing, fluidized bed combustion are prime candidates for further study in this area. The applicability of specific techniques (alone or in combination with others) depends heavily on the type and size of combustion equipment, and on the type of fuel used. Formulation of a simple, idealized model for NOX formation in combustion processes has been initiated. This study is aimed at the definition of requirements for more detailed combustion models, which could be used for guiding the design of combustion equipment emitting less NOX. (Author summary modified)

12633

F. E. Ireland

POLLUTION BY OXIDES OF SULPHUR. Chem. Eng., No. 221, CE261 -262, Sept. 1968.

The sources of sulfur oxide pollution include the combustion of sulfur-bearing fuels such as coal, coke, and fuel oil, the manufacture of sulfuric acid, miscellaneous uses of sulfur dioxide, and the combustion of sulfur compounds in waste gases from manufacturing processes. This is a brief report of these pollution sources made to the Working Party on Air Pollution of the European Federation of Chemical Engineering.

13053

Frantz, Robert L.

COAL STRENGTHENS ITS POSITION. Mining Engineering, 21(2):104-107, Feb. 1969.

Coal produces almost 2/3 of all the electrical energy generated by fossil fuels and 1/4 of all energy consumed in the U. S. Power company interconnections and cooperative agreements are being arranged to enhance power supply reliability and achieve minimum power costs. Many oil companies are seeking coal company affiliations or reserves. These mergers bring to coal companies a source of capital and expanded base operation for greater expansion potential. A commercial coal liquefaction plant will probably have a capacity of 100,000 bbl per day. It will require coal reserves of 400 to 650 million tons, with the mines producing 10 to 15 million tons per year. The magnitude and complexities of new mining operations require a high degree of engineering analysis and research to determine economic feasibilities and justify investments. A more concerted and intensive effort in the coal industry is required to attract additional manpower and expand training programs in the areas of production, maintenance, management engineering and safety.

13102

Carter, Christopher and Alwyn Jolly

LONGANNET CHIMNEY. Consulting Eng., 33(6):42-44, June 1969.

The reinforced concrete chimney at the Longannet Power Station, Scotland, is 600 ft high and designed to adequately disperse any contaminants remaining in the flue gas after electrostatic precipitation. The chimney is of multi-flue design with all boilers emptying into the single chimney for the purpose of combined efflux velocity for more buoyant gases because of the slower cooling rate of the greater mass of the combined gases. The flues extend 30 ft above the windshield of the chimney. This extension assists appreciably in avoiding downdrafts. Construction design is discussed.

13141

Kreimann, Herbert H. and Earl K. Rickard

HEAT EXCHANGE SYSTEM FOR HEATING MILL AIR AND FOR REHEATING STACK GAS SUBSEQUENT TO WET SCRUBBING. (Combustion Engineering, Inc., Windsor, Conn.) U. S. Pat. 3,447,492. 3p., June 3, 1969. 3 refs. (Appl. Dec. 27, 1967, 7 claims).

A fossil fuel-fired steam generator having a wet scrubber for removing sulfur and other impurities is described. A rear gas pass in the furnace, through which the combustion gases flow, is connected to the wet scrubber. A heat exchanger is positioned in the rear of the gas pass for absorbing heat from the hot combustion gases before they enter the scrubber. Another heat exchanger is positioned in the stack for heating the cleaned gases before they are discharged into the atmosphere. By raising the temperature of these gases, all the moisture they contain is evaporated, and they are able to leave the stack at an increased velocity. Both these factors help prevent a visible plume of the gases exiting from the top of the stack.

13219

Masek, Vaclav

ARSENIC IN COKE. (Arzen v koksu). Hutnicke Listy (Prague), 24(5):323-325, 1969. 18 refs.

Arsenic contained in coal used in coke ovens directly influences the quality of the coke and consequently the quality of cast iron and steel and of electrodes. The material of primary importance is black coal, in which arsenic is not evenly distributed. Arsenic content in a combustible is determined either by change of arsenic compounds to gaseous arsenic oxides or by transformation of arsenic compounds to volatile arsenic trichloride. Field testing of 35 specimens showed that the arsenic content is very low (0.002 to 0.005 mg/cu m). The present average value of arsenic allowed is 0.3 mg/cu m. In all places tested, the measured value was much lower than the allowable average. Dust taken from different strata at the test locations showed greater amounts, but still within the allowed limits.

13261

Voronov, F. D., I. A. Taldykin, B. L. Markov, V. G. Antipin, and V. F. Bogatenkov

DUST FORMATION IN A TWO BATH STEEL FURNACE. (Pyleobrazovaniye v dvukhvannoy staleplavil 'noy pechi). Text in Russian. Izv. Vysshikh Uchebn. Zavedenii Chernaya Met., no. 8:62-64, 1968. 2 refs.

Tests carried out on a 215 ton martensite furnace revealed that tuyere placement plays the greatest role in the production of lignite smoke, a major constituent of exhaust dust. During furnace operation without oxygen scavenging, the dust content of exhaust gases during filling, melting, and melt removal is 2.1, 1.4, and 1.3 g/cu m, respectively. Dust samples in this case contained 70-90% iron oxides, pointing to the metal bath as the main dust source, the presence of other metal oxides indicating slag and refractory materials as additional sources.

13292

National Coal Assoc., Washington, D. C., Dept. of Economics and Transportation

STEAM-ELECTRIC PLANT FACTORS, 1960. Fuel consumption and costss, plant capacity, net generation, 1960, and programmed capacity, 1961-64. Washington, D.C., National Coal Assoc., 1961, 37p.

The steam-electric utility plants studied consumed 266.7 million tons of fuel, including oil and gas on a coal equivalent basis, in 1960. This consumption represented increases in the use of coal, oil, and gas of 6.0, 1.4, and 9.2%, respectively, over the previous year. A breakdown of fuel consumption for regions is given. Plant capacities, net generation, fuel consumption, and unit costs for steam-electric plants in 1960 are tabulated. Predicted capacities are give for steam-electric, hydroelectric, internal combustion, gas turbine, and nuclear plants programmed for or under construction in the period of 1961 to 1964. Trends in the efficiency of coal utilization at steam-electric plants for the period 1950 to 1959 are discussed and tabulated. Total fossil fuel usage in the U. S. during the 1951-1960 period increased from 149.5 million coal and equivalent tons to 266.7 million tons, or by 76.0%. Oil and gas usage increased 39.6 and 125.4% in the same period. Coal, oil, and gas represented 66, 8, and 26% of the utilities' total fossil fuel consumption in 1960. The average 'as burned' cost of coal, oil, and gas to the utilities in 1960 was 26.0, 34.5, and 23.8 cents per million Btu, respectively.

13293

Arakawa, Yasuo and Yoshio Tanaka

NEW DEVELOPMENTS IN METHODS OF FORECASTING DEMAND FOR ENERGY. Preprint, World Power Conference, General Report, Section IA. (Presented at the Tokyo Sectional Meeting, World Power Conference, p. 185-191, Oct. 16-20, 1966).

The methods employed by 26 countries in forecasting demands for energy and electric power were evaluated. Two basic methods of forecasting are common to many countries: (1) the ecometric method of estimating demands by sectors and regions and (2) the trend method for extrapolating the rate of demand increases in time series. Developing countries often forecast future demand in the light of past growth of advanced countries. Few countries consider the limitations of demand forecasts based on statistical hypotheses; many fail to recognize changes in patterns caused by technological innovations. It is hoped that demand analysts will discuss these points as well as methods of forecasting load curves and estimating repressed demands caused by power shortages.

13316

National Coal Assoc., Washington, D. C., Dept. of Economics and Transportation

STEAM-ELECTRIC PLANT FACTORS, 1964. FUEL CONSUMPTION AND COSTS, PLANT CAPACITY, NET GENERATION, 1964, AND PROGRAMMED CAPACITY, 1965-68. 1965, 47p.

The 895 steam-electric U. S. utility plants studied consumed 347.3 million tons of fuel, including oil and gas on a coal equivalent basis, in 1964. This consumption represented increases in the use of coal, oil, and gas of 8.0, 10.1, and 7.3%, respectively, over the previous year. Fuel consumption by regions, and plant capacities, net generation, fuel consumption, and unit costs for steam-electric plants in 1964 are tabulated. Predicted capacities are given for steam-electric, hydroelectric, internal-combustion, gas-turbine, and nuclear plants programmed for, or under construction in, the period 1965-1968. Trends in the efficiency of coal utilization at steam-electric plants for the period 1954-1963 are discussed and tabulated. Total fossil fuel usage in the U. S. during the 1955-1964 period increased from 799.6 million coal and equivalent tons to 347.3 million tons, or by 74%. Oil and gas usage increased by 41.8 and 111.3% in the same period. Coal, oil, and gas represented 68, 9, and 23%, respectively, of the total fossil fuel consumption by utilities in 1955, and 65, 7, and 28% of the total in 1964. The average 'as burned' cost of coal to the utilities decreased from $6.07 per ton in 1955 to $5.89 in 1964. The cost per barrel of oil dropped from $2.14 to $2.06 and the cost of gas per million cubic feet increased from 18.8 to 26.4 cents during the same period. The national average cost (1955-1964) per million Btu of coal and oil decreased by 0.6 cents, and gas increased by 7.3 cents. The cost of coal and oil fell 2.4 and 7.8%, respectively, over the period, with an increase in gas of 40.6%.

13330

Unterberger, O. G. and M. S. Gofman

DUST FORMATION DURING IMPACT IN HAMMER CRUSHERS. Coke Chem. (USSR) (English transl.), no. 11:44-48, 1968. 3 refs.

A mathematical analysis of the dust yield obtained from raw coal mixtures crushed in hammer crushers is presented. Tests performed with a laboratory-sized hammer crusher gave results that were in close agreement with the theoretical approach. Two fundamentally different factors of dust formation in hammer crushers were found: (1) free-impact dust formation, and (2) dust formation resulting from abrasion as groups of particles slid across the working face of the hammer. The amount of dust formed by abrasion depended on the amount of dust in the starting mixture, and that formed by free impact was proportional to the linear speed of the hammers.

13401

Reid, W. T. and P. Cohen

FACTORS AFFECTING THE THICKNESS OF COAL-ASH SLAG ON FURNACE-WALL TUBES. Trans. ASME (Am. Soc. Mech. Engrs.), 66:685-690, Nov. 19 9 refs.

An equation is given relating thickness of slag deposit to slag flow properties, of the temperature of hot and cold sides of the deposit, and the volume of slag flow. The relative thickness of slag deposits for typical conditions can be calculated from this equation, providing a method of comparing the behavior of different coal ashes on furnace walls. For fixed furnace conditions, increas in the viscosity of the slag cause equal increases in the thickness of slag deposit. As the temperature of critical viscosity approaches the temperature of the furnace side of the slag deposit, there is a large increase in the thickness for all viscosities. For a fixed temperature of critical viscosity, there is an equal decrease in the thickness of the deposit for all viscosities as the temperature of the furnace side of the slag deposit is increased. The relationship between slag composition and relative thickness of deposit is shown for part of the field of composition of coal-ash slags. Increase in equivalent Fe203 content and decrease in ferric percentage, decrease the thickness of the deposit; CaO also decreases the deposit thickness as its content increases, the effect being greatest with slags containing less than 20% equivalent Fe203. (Author summary modified)

13410

Jones, J. F., R. T. Eddinger, and L. Seglin

MULTISTAGE PYROLYSIS OF COAL. Chem. Eng. Progr., 62(2):73-79, Feb. 1966. 3 refs.

Fluidized bed pyrolysis of coal, a process for upgrading coal by converting it to an oil, a gas, and a char, and to decrease the delivery of coal energy, is described. The coal used in testing the method was Illinois No. 6-seam coal. Multistage pyrolysis of coal was carried out in four stages. The temperature at each stage differed; liquor, char, crude oil, and gas were the by-products. Gases and dust leaving the reactor were quenched with water in venturi-type scrubbers and fibrous glass wool filters. Non-condensable gases were scrubbed to remove CO2, and yield a 550/btu/cu ft fuel gas, or the gas may be converted after scrubbing to produce a synthetic pipeline gas. The gas may also be converted to hydrogen and utilized in fertilizer. Tables evaluating the economic effects of multistage pyrolysis are given.

13479

Little (Arthur D.) Inc., Cambridge, Mass.

FUTURE MARKET FOR UTILITY COAL IN NEW ENGLAND. Contract 14-01-0001-489, Nov. 1966. CFSTI: PB 174 540

If no action is taken to reduce delivered coal costs from present levels, utility coal consumption in New England, after experiencing a steady growth, will reverse and begin a steady and continuous decline. At first this will be due to loss of the existing plant market to residual fuel, and later to loss of new plant market potential to nuclear power. If, as a consequence of initiating purchasing and transportation innovations, the delivered costs of coal can be reduced, coal can experience expanding demand through 1970. The potential market for coal appears large and stable enoug to justify taking action to reduce delivered costs. Incentives for such action in the form of lower fuel costs, increased coal sales, or higher gross weight revenues realizable by individual companies seem more than adequate. There is also the incentive of preserving coal as an effective competitor in New England's fuel economy.

13494

Dryden, I. G. C.

CHEMICAL CONSTITUTION AND REACTIONS OF COAL. In: Chemistry of Coal Utilization, Supplementary Volume, H. H. Lowry (ed.), National Academy of Sciences, Washington, D. C., Committee on Chemistry of Coal, p. 232-295. 1963. 392 refs.

Various methods of determining the chemical composition of coal are surveyed. Solvent extraction yields little information about the coal molecule, apart from a molecular weight distribution. If solvent extracts contain more than 1 to 5% of the parent coal, they resemble it closely, provided they are prepared below 250 C. If prepared above this temperature, pyrolysis has clearly modified their composition. The best specific solvents for coal contain a nitrogen atom with a readily available pair of electrons. Evidence from polarography has suggested that certain nuclei containing one, two, and three rings play an important part in coal structure. X-ray histograms suggest that about one-half of the carbon in the nuclei is almost equally distributed between one, two, and three rings, but these estimates may be biased toward the larger ring systems. In the polarography of coal extracts, the frequent occurrence of half-wave potentials, for the reduction of aromatic systems, points to the presence of a considerable proportion of biphenyl, naphthalene, phenanthrene, and triphenylene structures. The extent of reduction suggests a minimum polycyclic aromaticity between 0.35 and 0.5. Methods of functional group analysis and polarography at lower potentials have shown that the hydroxyl and carbonyl group concentrations account for 70 to 90% of the O2 in bituminous coal. Hydrogenation, extensive oxidation, hydrolysis, pyrolysis, and fluorination are the most interesting reactions of coal, but furnish only limited information about the structure of coal itself.

13511

Sarkar, G. G. and M. K. Sarkar

AN INTEGRATED APPROACH TO EVALUATION OF COAL WASHING EFFICIENCY. Proc. of the 5th International Coal Preparation Congress, Oct. 3-7, 1966. 36 refs.

Sharpness Index and Integrated Efficiency were evaluated in the laboratory as measures of the overall efficiency of coal washing operations. Sharpness Index is defined as 100 times the ratio of total misplacements to the amount of near gravity materials minus 100. Integrated Efficiency is defined as the recovery efficiency of cleans times the percentage yield of cleans plus the recovery efficiency of sinks times thhe percentage yield of sinks divided by 100. It is concluded that the values of Sharpness Index and Integrated Efficiency may be of great help in ascertaining the precision of any coal washing operation, as well as in the comparative evaluation of results of one or more separating processes under varying conditions of washing. Both are expressed on a percentage basis and take into account the quantitative and qualitative factors of a washing operation. The partition curve and its derivatives are considered suitable and will continue to find wide application for the prediction of the probable results of washing different types of feed coal by a particular process.

13515

National Coal Association, Washington, D. C., Dept. of Economics and Transportation

STEAM-ELECTRIC PLANT FACTORS. (FUEL CONSUMPTION AND COSTS, PLANT CAPACITY, NET GENERATION, 1963, AND PROGRAMMED CAPACITY, 1964-67.). Aug. 1964. 47p.

The steam-electric utility plants studied consumed 320.7 million tons of fuel, including oil and gas on a coal equivalent basis, in 1963. This consumption represented increases in the use of coal, oil, and gas of 9.3, 2.7, and 7.3% respectively, over the previous year. A breakdown of fuel consumption by regions is given. Plant capacities, net generation, fuel consumption, and unit costs for steam-electric plants in 1963 are tabulated. Predicted capacities are given for steam-electric, hydroelectric, internal-combustion, gas-turbine, and nuclear plants programmed for or under construction in the period of 1964 to 1967. Trends in the efficiency of coal utilization at steam-electric plants for the period 1953-1962 are discussed and tabulated. Total fossil fuel usage in the U.S. during the 1954-1963 period increased from 175.8 million coal and equivalent tons to 320.7 million tons, or by 82.4% Oil and gas usage increased 41.7 and 92.7% in the same period. Coal, oil, and gas represented 65, 9, and 26% respectively, of the utilities' total fossil fuel consumption in 1954 and 65, 7, and 28% of the total in 1963. The average 'as burned' cost of coal to the utilities decreased from $6.31 per ton in 1954 to $6.02 in 1963. The cost per barrel of oil rose from $2.10 to $2.11 and the cost of gas per Mcf increased from 18.1 to 26.6 cents during the same period. The national average cost (1954-1963) per million btu of coal decreased by 1.1 cents, while oil and gas costs increased 0.7 and 8.6 cents, respectively. The cost of coal fell 4.2% over the period, with respective increases for oil and gas of 7.1 and 49.7%.

13644

Hino, Yoshinori

ON SULFUR CONTENTS IN COMBUSTION GAS FROM BROWN COAL. (Kattan nensho hai gasu chu no iwo ganyuryo ni tsuite). Text in Japanese. Netsu Kanri (Heat Engineering, Tokyo), 21(5):38-43, May 1969.

Of all combustion gases, sulfur dioxide receives the most attention, since the degree of air pollution is generally measured by the amount of sulfur dioxide. Sulfur in its liquid and solid states is found in combustion gas whenever it is burned. Ashes of brown coal contain larger amounts of lime and magnesium present as $CaSO_4$ and $MgSO_4$. In the case of brown coal from the Rhine district, Germany, a large quantity of sulfur is found in the combustion ashes and the amount of sulfur present in the combustion gas is therefore lessened. More than 30% of the electric power in West Germany is produced in the Rhine district. Brown coal, costing little and containing little sulfur in its combustion gas, is the primary energy source for this electric power. To discover the outstanding advantage of this coal, tests were conducted with a variety of equipment in the boiler of a mountain power plant's briquet factory. Sulfur dioxide concentrations were measured with Woesthoff equipment and sulfur trioxide by the Stratmann-Schuster method. To check the amount of sulfur in combustion gases, the on-balance content of sulfur in ashes was also investigated. Experimental results indicate that the longer the combustion gas remains in the boiler, the greater the amount of sulfur formed.

13785

Teitelbaum, Perry D.

ENERGY PRODUCTION AND CONSUMPTION IN THE UNITED STATES: AN ANALYTICAL STUDY BASED ON 1954 DATA. Washington, D. C., Dept. of the Interior, Bureau of Mines, Report of investigations, 5821, 145p., 1961. 23 refs.

All available statistical data on energy production, transformation, and use for 1954 were collated and analyzed in detail to improve the understanding of the economics of energy production and consumption. Main topics are: the pattern of energy flows in 1954; notes and comments on the scope and adequacy of energy statistics; and energy origin and disposition in 1954 and other years. Numerous tables are presented throughout text in six appendices. The study presents an energy balance sheet for the U. S. in 1954, and includes data and discussion of all forms of coal, gas, oil, wood, and hydroelectric power.

13832

Pope, Evans and Robbins, New York

COAL-FIRED HEATING PLANT PACKAGE: PHASE II REPORT. OCR Contract 14-01-0001-242, 63p., Nov. 1, 1963. CFSTI: PB 181-585

A complete steam generating package consisting of a bellied-in header innovation of an 'A' type boiler with a drawer type, single feed spreader stoker, forced draft fan, ash reinjection/over-fire air system, and combustion feed and control has been devised as the ideal combination for a packaged coal fired boiler. The design provides for a specially designed dust-collector induced draft fan, and optional economizer, package to be field installed as a single unit on top of the boiler drum. Automation is achieved to the extent that only one man is required for normal operation of the plant. Boilers, coal, and ash handling systems operate on a fully automatic basis. The use of a continuous dual-purpose drag chain is an integral part of the design, the upper run of the chain delivering coal to all boiler hoppers and the lower run removing the ashes simultaneously. Considerable savings in erection costs have been achieved by extensive packaging of plant auxiliary and construction components. If a comparison is made with recent boiler plant construction costs, it can be seen that this type of boiler plant can be erected for a fraction of the cost of a traditional field-erected plant. (Author summary modified)

13848

Krumin, Peter O.

THE MEIGS CREEK NO. 9 COAL BED IN OHIO. PART III FURTHER STUDY OF THE CHEMICAL AND PHYSICAL PROPERTIES, AND WASHABILITY CHARACTERISTICS, WITH A BRIEF REVIEW OF NEW METHODS EMPLOYED. Ohio State Univ. Studies, Eng. Ser., Eng. Exp. Station Bull. no. 165, 26(3): 375p., July 1957. 181 refs.

The results of examining some existing methods and of developing new or modified methods for the determination of various properties of coal are reported. Equilibrium moisture, mineral CO2, total S by the LECO high-frequency induction furnace method, forms of S, low-temperature carbonization, and float and sink testing of both coarse and fine coal are covered. The results of studying 57 samples from the Meigs Creek no. 9 coal bed are given. Seventeen composite samples were prepared from the 57 individual sections. Each of these represented the cross section either of separate benches or of the entire thickness of the coal bed at 14 sampling sites. Fifteen of the composite samples were screen-sized, and each screen size was analyzed for moisture, ash, and S. The results of screen analyses are presented in tabular and graphical form. Results of the float and sink tests on the 17 composite samples are presented in tabular and graphical form, as washability curves. 'Float ash' curves for various screen sizes obtained from the same sample for each of 15 composite samples are presented to show the effect of crushing on ash reduction, or yield of float coal at a selected constant ash content. Heating values in all specific gravity fractions of one screen size from each of the 17 composite samples were determined. The results of the study of analytical methods and the results of the investigation of Meigs Creek no. 9 coal are summarized in 63 tables, 134 data sheets, and 29 figures. (Author summary modified)

13855

Violet, P., A. Aynard, and G. Dumarchey

CHECK ON THE OPERATION OF COMMUNAL CENTRAL HEATING BOILERS IN LYONS DURING WINTER 1967-1968. (Controle du fonctionnement de chaudieres de chauffage central collectif a Lyon pendant l'hiver 1967-1968). Text in French. Pollut. Atmos. (Paris), 11(41):15-19, Jan./March 1969.

The Lyons Health Office, working in collaboration with technicians of the Association Lyonnaise des Proprietaires de Machines a Vapeur et Electriques and with financial assistance of the Centre Interproffesionel et Technique d'Etudes de la Pollution Atmospherique, carried out inspections, during the winter of 1967/1968 on 44 boilers whose calorific capacities ranged from 170 therm/hr to 5015 therm/hr. Thirty-nine units burned fuel oil and five coke or coal. In 97% of the cases, the Bacharach index was below 6. In 91% of the cases, the temperature of the smoke was below 300 C, with CO2 exceeding 9% for 44% of the operations checked. Forty-seven boilers, ranging from 50 to 1250 therm/hr, already checked in 1966/1967, were again inspected. A slight improvement was noted with regard to combustion. (Author abstract modified)

13892

Conklin, Edwin R.

1968 ANNUAL STATISTICAL REPORT: PART 2. Elec. World, 169(8): 69-96, Feb. 19, 1968.

The electric power industry is expected to add 172,145 Mw to existing generating capacity by 1974. This increase in capacity will amount to a gain of 64.5%. By 1974, nuclear power will account for 12.5% of the industry total as compared to 1.0% for 1967, and will, therefore, become an important segment of the electric power industry. The various aspects of electrical power generation and the capacity additions in different regions of the U. S. are presented graphically and in tabulated form.

13954

Morrison, Warren E.

THE ENERGY DILEMMA - WHICH FUEL, WHAT MARKET, WHEN/ Preprint No. 65K302, Society of Mining Engineers, AIME, N. Y., 26p., 1965. (Presented at Rocky Mountain Minerals Conference, Fall Meeting of the Society of Mining Engineers, Phoenix, Ariz., Oct. 7-9, 1965.)

The future energy economy is forecast over 5-year intervals, spanning 15 years, in terms of the future demand for specific resources and the levels of domestic supply and foreign trade required to meet this demand. The forecast includes a short-term forecast to 1965, two intermediate forecasts to 1970 and 1975, and a terminal forecast to 1980. The basis of the forecast is the historical balance of gross consumption of energy by consuming sectors during the period 1947-1963. Through the application of econometric procedures and forecasting techniques, the components of the historical balance are projected forward and composite energy balances are drawn up for each of the forecast periods. Separate projections are made for each major energy resources--coal, natural gas, petroleum, hydropower, and nuclear power; for the four major energy markets--household and commercial, industrial, transportation, and utility power; and for the basic form that resources assume within these markets-- electricity, direct fuels, and raw materials. While total energy is projected to increase at a rate of 3.2, petroleum and natural gas will grow at somewhat slower rates than in the historical period. Nevertheless, the two resources are expected to account for 73% of total energy consumption in 1980. Bituminous coal, due to its demand for utility electricity, will grow at a rate of 2.4% but will provide a smaller portion of total energy by 1980. Conventional energy sources will feel the impact of commercial nuclear power, which will constitute 5% of total energy by 1980. Hydropower will grow at about the same rate as during the historical period.

13963

Morrison, Warren E. and Charles L. Readling

AN ENERGY MODEL FOR THE UNITED STATES, FEATURING ENERGY BALANCES FOR THE YEARS 1947 TO 1965 AND PROJECTIONS AND FORECASTS TO THE YEARS 1980 AND 2000. Information Circ. 8384, Washington, D. C., Dept. of the Interior, Bureau of Mines, July 1968, 127p. 24 refs.

A simplified energy model for the U. S. is quantified for 1947-1965. The basic model and calculated quantified structures are used for a number of analytical case studies that estimate mid-term and long-range shifts in patterns of energy resources demand and required supply. Historical data series are presented in the form of integrated energy balances by source, form, and consuming sector. In case studies I to XII, conditional projections of historical trends of energy demand and required supply are made for the midterm period 1966 to 1980. The projections are carried out by correlation of major energy components with relevant independent variables such as major economic indicators. Simulations of the medium-range projections to 1980 are carried out by varying the assumptions for midterm period. Case studies XIII to XXII are long-term contingency or technological forecasts to the year 2000. These cases assume technological changes or innovations that produce major shifts in the long term pattern of energy consumption and the mix of required resources. The domestic resource base is assessed in its ability to meet projected or forecast demand for energy resources under the midterm and long-run assumption made in the various case studies. Various energy issues or problems identified from the analyses of the case studies are discussed, and possible alternative approaches to solutions are suggested. (Author abstract modified)

13978

Angelova, G., L. Lazarov, and V. Kovaceva

BEHAVIOR OF SULFUR COMPOUNDS IN COAL DURING TREATMENT WITH SODIUM IN AN AMMONIACAL SOLUTION. (Ueber das Verhalten der Schwefelverbindungen in der kohle bei deren Behandlung mit Natrium in ammoniakalischer Loesung). Text in German. Brennstoff-Chem. (Essen), 50(1):11-14, Jan. 1969. 26 refs.

Coal samples with different S contents and of different degrees of carbonization were treated with sodium in an ammoniacal solution at -35 C. In this process, a decomposition of the pyrite and a rupture of C-S-C bonds in the organic constituent occur with formation of mercaptans, sodium sulfide, and hydrogen sulfide. While the sulfide and disulfide bonds are readily broken, heterocyclic bonds are not. The abovementioned treatment of coal provides a deeper insight into the nature of the organically-bound S and leads to the realization that in the cokable and sulfur-rich coals, the share of the rupturable C-S-C bonds is considerable, whereas in the less carbonized, non-cokable coals, it is quite small. The behavior of the S- bonds during this treatment is compared with that of the O-bonds.

14378

Roggendorf, Alexander

DOES THE CHANGEOVER TO GENERATION OF ELECTRICITY IN NUCLEAR POWER PLANTS LEAD ONE TO EXPECT A CHANGE OF STRUCTURE OF THE CURRENT DISTRIBUTION NETWORKS/ (Laesst der Uebergang zur Stromerzeugung in Kernkraftwerken eine Strukturaenderung der Stromverteilungsnetze erwarten/). Text in German. Elektrizitaetswirtschaft, 67(3):49-52, Jan. 29, 1968.

Power generation using heavy fuel oil, a by-product in the refining of mineral oil, is rather new in Germany. Price of heavy fuel is low, and with the development of oil refineries everywhere in the country, more such power plants could be erected. In spite of the fact that nuclear power plants will inevitably become predominant within the next ten or twenty years, these heavy fuel oil-fired power plants will probably last a long time, since oil will be refined for the use of engine propellant well into the next century. Furthermore, it is less expensive to use the heavy oil in power plants than to hydrate it for additional propellants. With the advent of more nuclear power plants, the tendency to produce electricity at the site of consumption rather than erection of long-distance networks will certainly become more prominent. Industries may then develop in parts of the country which so far have lacked primary energy. Network costs will decrease, and industries will be able to spread out and benefit everyone.

14400

Beveridge, G. S. G. and C. A. MacArthur

SULPHUR EMISSION TO THE ATMOSPHERE. Chem. Engr. (London), 47(6):304-305, July-Aug. 1969. 7 refs.

The sources of sulfur emission in Great Britain are discussed. Sulfur pollutants are essentially derived from conversion processes of the chemical industry, including cement manufacture, metal ore treatment, and smelting, and also from industrial and domestic energy conversion systems. Two examples of sulfuric acid production and the production of electricity from coal and oil are considered as representatives of the main large-scale sulfur sources. Apart from other industrial boiler installations and domestic users, who are also significant contributors, the sulfur pollution load from existing power generating stations is much greater than that from the chemical industry. Several processes are available for reducing or removing sulfur from oil, but only one-third of the refineries in England and Wales practice sulfur recovery to any extent. The present removal method is the desulfurization of fuel. If emissions from power stations were subject to the same rigorous scrutiny as those from chemical works, sulfur would have to be recovered at some stage. If the use of a low-sulfur source were a condition of fueling power station, low-sulfur oil might soon be available at competitive cost. The government could encourage this availability by exempting low-sulfur oil from part or all of the fuel oil surcharge. This would give some protection to the coal industry but would have the beneficial effect of reducing atmospheric pollution. It seems unreasonable to accept a high level of pollution from power plants when chemical and petroleum emission are limited by considerable capital expenditure.

14478

Seidl, W.

ON THE QUESTION OF POWER PLANT EMISSIONS. (Zur Frage der Kraftwerkemissionen). Text in German. Brennstoff-Waerme-Kraft, 21(5):265-267, 1969. 3 refs.

Important developments in the field of CO2, SO2, and fly dust emissions in the U. S. are briefly summarized. Computations and estimations of the CO2 emissions conducted by the National Center for Air Pollution Control of the Public Health Service showed that since 1890, the annual CO2 emissions have increased enormously, and by the year 2000, they are expected to have increased 18 times. The highest growth has been predicted to fall within the period from 1965 to 1985. The CO2 emitted by thermal power plants stems primarily from the combustion of coal. In the past, thermal power plants played a rather unimportant role as emission sources for CO2. In the period between 1980 and 1990, they are estimated to become major sources of CO2 emissions. By the end of the century, vehicles will again be the prominent CO2 emission source. Presently in the U. S., about 40 times 10 to the ninth power tons per year of CO2 are emitted; this figure will rise to almost 100 times 10 to the ninth power by the year 2000. The Institute of Industrial Medicine of the New York University Medical Center studied fly ash from electrostatic precipitators in various thermal power plants fired with bituminous coal from the Appalachians. Their radiochemical analyses yielded average radioactivities for Ra226 plus Ra228 of 6.2 pc/g. If it is assumed that a power plant with a capacity of 1000 MW consumes 2,000,000 tons/year of such coal with an ash content of 9%, and if 2.5% of the ash leave the precipitator, a fly ash emission of 4.5 times 10 to the 9th power g/year with a radioactivity of 28 mc/year is obtained. As far as desulfurization is concerned, the dolomite process will be used by Union Electric and the Tennessee Valley Authority.

14574

Dratwa, Heinrich

RIDDING THE AIR OF SULFUR OXIDES - PROBLEMS AND POSSIBILITIES. (Die Reinhaltung der Luft von Schwefeloxiden - Problematik und Moeglichkeiten). Text in German. Tech. Ueberwach. (Duesseldorf), 8(5):153-157, May 1967. 40 refs.

Sulfur dioxide tops the list of emitted toxic gases. In the Ruhr valley alone, 36% of the total quantity of gases emitted to the atmosphere consists of SO2. Statistics based on fuel consumption show that industry contributes 80.2% and domestic heating 19.8%. Extensive measurements confirmed these data. It was found that power plants emit 38%, industrial plants 41%, and domestic heaters 21%. These emissions are particularly damaging to plants, while sporadic cases of injury to humans and animals have become known. In the Federal Republic of Germany, maximum allowable concentrations have been legally set which must not be exceeded even temporarily. Fuel oils are frequently desulfurized prior to use. Coal contains organically bound sulfur (about 0.6 to 0.9% by weight) and inorganically bound sulfur (can reach 5% by weight). Regulations exist in West Germany which require switching to low-sulfur fuels during inversion weather. Construction of high stacks might be of help in single industrial complexes in the open country. Another way to avoid SO2 emission and corrosion of heating surfaces is the use of additives such as dolomite, magnesium oxide, limestone or oxidizing catalysts. Still another way is the removal of sulfur dioxide from the waste gas by absorption or adsorption. There are several ways to do this. The first is to dissolve the sulfur dioxide in special solvents or in water, but this process is uneconomical up to concentrations of 10% by volume. The second method is to dissolve substances in water which bind SO2 or SO3 chemically. Generally, it can be said about these methods have not been successful, and there is a preference for SO2 adsorption on activated charcoal or low-temperature coke.

14701

Bretschneider, B.

MAIN SOURCES OF INDUSTRIAL GASEOUS EMISSIONS. (Hlavni zdroje prumyslovych plynnych exhalaci). Text in Czech. Ochrana Ovzdusi, no. 2:26-30, 1969. 29 refs.

Sulfur dioxide is the most harmful gaseous emission in Czechoslovakia. The primary source of sulfur dioxide emission, which reached approximately 25 million tons in 1966, are power engineering, e.g., powerhouses, boiler houses, heat plants, etc., surface mining of sub-bituminous coal in Northern Bohemia, and domestic fireplaces. The latter are particularly important sources of pollution in residential and urban areas. Powerhouses of the Central Board of Power Engineering emit as much sulfur dioxide as the powerhouses and boiler houses of industrial plants. Their emissions contaminate the lower atmosphere of whole areas. Air quality in the CSSR, especially in Northern Bohemia and around industrial complexes, can be raised by controlling the diffusion of sulfur dioxide and combustion products in the lower atmosphere. Less important sources of gaseous emissions are metallurgical engineering plants, which produce both sulfur dioxide and monosulfide, and chemical works whose emissions, though low, can be extremely harmful. Emissions from powerhouses of industrial plants are of local importance.

14794

Matthews, K. J.

CONTROLLING THE LUMINOSITY OF NATURAL GAS FLAMES IN CONVERTED POWER STATIONS. Termotecnica (Milan), 23(8):402-416, 1969. 17 refs. (Presented at the Convention 'I problemi della combustione-Bruciatori', Milan, Italy, June 18-19, 1969.)

An experimental natural gas burner, which produces a stable luminous flame with air velocities similar to those encountered in current oil burners was used to study the influence of various input variables on the flame luminosity, which, together with radiative power, are controlled by rates of soot formation and, to a lesser degree, by burnout. Conditions which favor soot production and hence flame luminosity were established and were found to be in conflict with the conditions necessary for good flame stability in converted front wall burners. A two stage combustion system is therefore suggested. Some gas should be burnt in a region of low velocity to form a stable pilot flame which will anchor the rest of the flame. The bulk of the gas should then be introduced into the air stream at the same velocity as the air so that a good proportion of it is heated rapidly in the absence of oxygen to produce soot. The practical problems involved in such a system are discussed, and methods of controlling soot burnout by the amount of excess air in the flame or by the temperature of the secondary air, and flame radiation by increasing the initial mixing rates, are considered. The experimental apparatus, methods, and data are given in detail. The experimental burner had a peak total flame emittance of 0.4 from a flame only 510 mm thick.

With the same soot concentration in a power station-scale flame about 2 m thick, it is calculated that the total flame emittance, about 0.85, would be comparable with values obtained for oil or pulverized coal flames. Further development of the stabilizer system should permit another increase in scale to a full-size power station burner of about 30 MW (100,000 cu ft/hr).

14980

Vogely, William A.

MODELS OF ALL-GAS AND ALL-ELECTRIC ECONOMIES. In: Energy. L. B. Holmes (ed.), Evanston, Ill., Northwestern University Press, 1968, Chapt. 7, p. 63-82. 3 refs.

Modern technology is greatly increasing the range of technical substitution between primary energy resources to provide useable energy to people; and areas which are now the sole province of a single energy source, such as petroleum and automobile transportation, should in the future become competitive. Ten contingency models of the energy economy are presented as a guide to energy research and development expenditures. A conventional model, reporting the actual 1966 situation and a probability forecast for 1980 and 2000, is the starting point of the analysis. Three all-gas models and six all-electric models are derived. These models illustrate the possibility of achieving resource savings through technology; they also establish outside parameters for specific fuel use. The range in gross energy inputs from the highest to the lowest model is 2.7:1, which widens to 6:1 in terms of resources in the ground. The most efficient, in resource use sense, is the all-gas model utilizing small hydrocarbon air fuel cells for onsite generation of electrical power. The least efficient are oil fired central generating plants with all energy used in the form of electricity. However, the actual energy mix will be determined by economic factors, not absolute efficiency criteria. (Author abstract modified)

14997

Hilst, Glenn R., John E. Yocom, and Norman E. Bowne

THE DEVELOPMENT OF A SIMULATION MODEL FOR AIR POLLUTION OVER CONNECTICUT. VOLUME 1. (SUMMARY REPORT.). Travelers Research Center, Inc., Hartford, Conn., Grant RSA-67-4, 66p., Oct. 1967. 3 refs. CFSTI, DDC: PB 182 608

A working, computer-oriented simulation model of the statewide Connecticut air pollution system was developed. This simulation model is designed to estimate the cumulative air pollution loading of Connecticut's atmosphere with a spatial resolution of one mile and a time resolution of one hour. Any arbitrary distribution of the air pollution sources can be evaluated with regard to resultant air quality over the region. As a management tool for evaluation of alternative air pollution control practices, this model provides an unprecedented information and evaluation system. In addition to the construction of this very versatile simulation model, an inventory of the location and hour-by-hour emission rates of the varied sources of five pollutants was completed, the major variabilities of the atmospheric dispersion processes over Connecticut were assessed. These products serve as the input variables to the simulation model. The source inventories show that, in 1967, man-made sources of air pollution in Connecticut will emit some 300,000 tons of oxides of sulfur, 129,000 tons of the oxides of nitrogen, 1,290,000 tons of carbon monoxide, 328,600 tons of hydrocarbons, and 63,900 tons of suspended particulates. Exemplary calculations of the expected air pollution levels in Connecticut under various meteorological conditions, as predicted by the simulation model, are presented. These examples show clearly the regional variability of air quality; they illustrate the power of the model to evaluate of complex planning and control problems inherent in effective air resource management. Connecticut will have the advantage of a system that can evaluate the air quality implications of control plans before they are implemented and also define, in unprecedented detail, the causes of present and future air pollution problems. (Author summary modified)

15146

Balazs, Zoltan and Andras Juhasz

EXAMINATION OF THE SULFUR CONTENTS OF THE BORSOD-BASIN BROWN COALS. (A borsodi barnaszenek kentartalmanak vizsgalata). Text in Hungarian. Banyasz. Lapok, 102(6):408-418, June 1969. 9 refs.

Based on 8961 analyses, the average sulfur content of 'Borsod' coals was found to be 2.6%; the upper and lower limits were 0.5% and 3.5%; 307 petrographical investigations showed that two-thirds of the sulfur is in globulites thought to be of bacterial origin. Calculated on the basis of the 307 microscopic preparations, the sulfur content averaged 3.51% (between 0.8% and 5.1%). Based on the analysis of 2079 samples, the iso-sulfur lines of the five coal fields of the Borsod Basin are shown on five maps in connection with the caloric value of the individual areas. The heat value of the basin is below 3600 kcal/kg. As the heating value increases from 0 to 3600 kcal/kg, the sulfur content increases from approximately 0.7% to 2.7%; the steepest increase in sulfur content (0.087%/100 kcal/kg) occurs between 200 and 2000 kcal/kg and the smallest increase (0.029%/100 kcal/kg) between 2000 and 2900 kcal/kg. A theory is presented to explain the correlation between the high heating value of the coal and the increase in sulfur content.

15246

Horn, K., A. Knauer, P. Liebscher, and K. Thorandt

ON THE QUESTION OF AIR POLLUTION BY LARGE SOFT COAL-FIRED POWER PLANTS. RESULTS OF YEAR LONG DUST FALL MEASUREMENTS IN THE AREA OF HIRSCHFELDE. (Zur Frage der Luftverunreinigung durch Grosskraftwerke auf Braunkohlenbasis. Ergebnisse einjaehriger Staubsedimentationsmessungen im Raum Hirschfelde). Text in German. Z. Ges. Hyg. (Berlin), 14(5):360-362, May 1968.

In the area of Hirschfelde, East Germany, where air pollution stems almost exclusively from two soft coal-fired power plants, dust fall measurements were taken at 10 stations over a period of one year. Glass containers (DIN standard 5073) with a collecting area of 63.6 sq cm were set up. The glasses were filled with distilled water and, in winter, with 100 ml glycerine as well. Exposure time generally extended over two weeks. The results show dust fall varies greatly with time and location, decreasing with increasing distance from the power plants. Computation of the frequency distribution of the 248 individual measurements yielded a logarithmic distribution. At the five stations with the highest dust fall, the average concentration was 725, 276, 143, 128, and 116 g/sq m per day.

15391

Spaite, Paul W. and Robert P. Hangebrauck

ENVIRONMENTAL QUALITY THROUGH RESPONSIBLE RESOURCE MANAGEMENT. Preprint, Canadian Society of Chemical Engineers, Edmonton, Alberta, 11p., 1969. 8 refs. (Presented at the Canadian Chemical Engineering Conference, 19th, Edmonton, Alberta, Oct 19-22, 1969.)

Sulfur dioxide pollution from power plants using coal represents a major segment of the total air pollution problem, requiring the development and use of both short-term and long-term applications. Remote siting of power plants with tall stacks appears to become less effective as plant capacities grow. Other aspects of siting, such as location of plants near low sulfur western coal reserves and use of advanced lower-cost power transmission may have more impact. Although naturally occurring sulfur coal and 'cleaned' coal may provide a means for minimizing pollution, especially in some areas, their use is limited. Increased use of desulfurized residual oil and natural gas becomes uneconomical, in addition to a shortage of supply. Processes for removal of sulfur dioxide from power plant flue gas have so far been uneconomical; thus research is being conducted on a variety of process types that are capable of application to different segments of the total problem, such as limestone-based processes (dry injection and wet lime scrubbers). Programs have also been developed for coal gasification or conversion to clean fuels.

15517

Public Health Service, Washington, D. C., National Air Pollution Control Administration

CONTROL TECHNIQUES FOR SULFUR OXIDE AIR POLLUTANTS. NAPCA Publ. AP-52, 122p., Jan. 1969. 274 refs.

About 75% of sulfur oxide emissions in 1966 resulted from the combustion of sulfur-bearing fuels, with coal combustion accounting for the largest part. The economic and technical aspects of various techniques for controlling these emissions are examined in detail; they are categorized as (1) change-over to fuels with lower sulfur content or to another energy source, such as hydroelectric or nuclear power; (2) desulfurization of coal or residual fuel oil; (3) removal of sulfur oxides from flue gas by various processes, including limestone-dolomite injection and alkalized alumina sorption; and (4) increase in combustion efficiency. Of the industrial sources of SO2 emissions, nonferrous primary smelting of sulfide-containing metallic ores such as copper, zinc, and lead is the largest emitter. About half of the primary smelters in the U. S. now use sulfuric acid recovery to reduce emissions and at the same time offset smelter operating costs. Smelters, oil refineries, pulp and paper mills, steel plants, sulfuric acid plants, waste disposal processes, and a number of other industrial sources are considered in terms of present technology for reducing emissions. The costs of dispersion of sulfur oxides by tall stacks are briefly discussed as an approach toward reducing the frequency of high concentrations at ground level in some areas, and an extensive bibliography on gas dispersion is included. An appendix on chemical coal processing describes the current state of development of such methods as gasification and liquefaction for reducing the sulfur content of high-sulfur coal.

15620

Ohya, Masaaki

NITROGEN OXIDES FROM STATIONARY COMBUSTION FURNACE. (Koteinenshosochi karano chissosankabutsu). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(8):448-456, Aug. 25, 1969. 10 refs.

Sources of nitrogen oxides in the atmosphere and existing methods of control are reviewed. Nitrogen oxides are monitored mainly by electrical conductivity measurements or photo-electric colorimetry. In urban areas, they are primarily produced by the combustion of heavy oil, gasoline, or coal. The automobile exhaust is the main source of ambient nitrogen oxides, which are produced by the oxidation of nitrogen in the combustion chamber air of the engine. Their amount is determined primarily by the fuel ratio. Nitrogen oxides emission from stationary combustion furnaces, on the other hand, are not very serious at present. but have growing importance. Nitrogen oxides are more difficult to control than sulfur oxides; control is effected either by a wet system using venturi scrubbers, or a dry system using adsorbents, such as an active carbon. Several ways are described for controlling combustion. It is emphsized that those methods of combustion control do not apply to other harmful pollutants. A method of simultaneous removal of sulfur dioxide and nitrogen oxides is also described, together with the use of a catalyst for converting SO2 and nitrogen oxides into sulfuric and nitric acids respectively, and subsequently removing these acids by rinsing. Future development of control techniques is desired.

15701T

Fortak, H.

COMPARISON OF COMPUTED AND MEASURED MAXIMUM AIR POLLUTIONS AND THEIR DISTANCE FROM THE SOURCE IN THE CASE OF LARGE EMITTANTS. (Vergleich von berechneten und gemessenen maximalen Bodenimmissionen und deren Entfernungen von der Quelle fuer den Fall von Grossemittenten.) Translated from German. Free Univ. of Berlin, Inst. for Theoretical Meteorology, 21p., 1968. 7 refs.

A simplified version of the theory of atmospheric diffusion is applied to simulate maximum ground-level SO2 concentrations measured near large power plants. The results depend strongly on the special form of the plume rise formula. Neither Csanady's original formula nor the new optimized version of it give satisfactory results. A slight modification of the exponent in the optimized Csanady-formula however seems to simulate the measurements in the best way. The simplest way to determine the minimum stack height of large power plants is to limit the calculation to the adiabatic lapse rate and obtain the stack height from a given equation.

16073

Texas Air Control Board, Austin and Public Health Service, Durham, N. C., National Air Pollution Control Administration

REPORT FOR CONSULTATION ON THE METROPOLITAN DALLAS-FT. WORTH INTRASTATE AIR QUALITY CONTROL REGION (TEXAS). 29p., Oct. 1969. 7 refs.

A ten-county air quality control regiois proposed to abate air pollution in the metropolitan Dallas-Fort Worth area. The proposal is the result of two studies relevant to the problem of defining the boundaries of air quality control regions. The first was an evaluation of the area's topography, air pollutant emissions, meteorology, estimated air quality levels, and available air quality data; and second, a study of the location of population and industry, population density, projected growth of population and industry, and jurisdictional considerations. Emission densities were calculated from emission quantities and grid areas. Emissions and meteorological data were used in a diffusion model to estimate air quality levels. Although prevailing area winds promote dispersion, thermal inversions occur about 35% of the time. Dallas and seven other counties are experiencing suspended particulate levels higher than background levels. While not an area-wide problem, sulfur oxides are present in Dallas and Tarrant, which are the major point sources of pollution. Portions of most counties are experiencing carbon monoxide pollution, the distribution of which correlates with major traffic patterns. Despite the low air pollution potentional in several counties, it is logical to include them in the air quality control region, since they too administer the North Central Texas Council of Governments.

16212

DeCarlo, Joseph A., Eugene T. Sheridan, and Zane E. Murphy

SULFUR CONTENT OF UNITED STATES COALS. Bureau of Mines, Information Circ., no. 8312, 44p., 1966.

The coal reserves of the United States occur in thousands of different seams that have widely varying sulfur contents. Both high and low-sulfur coals are mined, with the production of coals of various sulfur contents depending chiefly upon their end use. Nearly two-thirds of the total coal remaining reserve is low-sulfur coal. Roughly, three-fourths is sub-bituminous and lignite (low rank) and the balance is bituminous and anthracite. The sulfur content of bituminous coals varies considerably. Approximately 166 million tons of the total bituminous coal was low-sulfur coal. Approximately the same proportion of the total produced could be considered medium-sulfur coal, while the remaining balance of about 28 percent had a high-sulfur content. Anthracite generally contains less than 1 percent sulfur. Sub-bituminous and lignite, also are generally low in sulfur. Approximately 47% of the bituminous-coal output is burned by electric utilities. Coals so consumed generally may be classified as medium-sulfur coals, as the average sulfur content of shipments to utilities in 1964 averaged about 2.3%. The coking industry probably has the most stringent sulfur requirements of any of the major consumer groups because of the effect of the chemical constituents of the raw materials on end products. The average sulfur content of coals carbonized is about 1%. In order to utilize some coals which contain more than 1% sulfur, the coke industry does considerable blending of medium and low-sulfur coals. Sulfur content of the coals currently used for other industrial purposes and space heating in homes, business establishments, schools and Government buildings probably falls between that used by electric utilities and coke plants. A survey of coal used by Government buildings for the year 1964 showed an average sulfur content of 1.1%. The sulfur content of exported coals is low, since the bulk of the exports are metallurgical or special-purpose coals and contain 0.7% or less sulfur. (Author summary modified)

16239

Thring, M. W.

FUEL AND ENERGY PROBLEMS IN THE NEXT THIRTY YEARS. Preprint, Combustion Engineering Assoc. Hayes, Middx., Great Britain, 2lp., 1969. (Presented at the Combustion Engineering Assoc. Meeting, London, April 10, 1969, Document 8622.)

Within the next 30 years, world fuel requirements will probably increase by a factor of the order of ten, and improved combustion engineering techniques are necessary for the proper use of world fuel resources. Even though mole drilling operations may add to the proved resources of petroleum, there are definite and foreseeable limitations to world hydrocarbon resources. Natural gas is even more limited than petroleum and also much more difficult to transport. Coal resources are at least 100 times greater than other hydrocarbon resources, and it is anticipated that electricity will be generated from coal by underground gasification and combustion processes. Development of mechanical engineering techniques should also make it possible to exploit two other sources of hydrocarbon fuels: the Athabascan tar sands and Colorado oil shales. Within the next thirty years, the cost of electricity generated by nuclear fission will drop to about half the present cost of electricity. Commercial-scale nuclear fusion processes are likely to be a reality in 40 years. Once they exist, fuel will be unlimited because deuterium is present in all water. It is hoped that the thermal efficiency of power stations will be increased by the use of multifluid cycles and by processes which will run boilers on a heavy fuel oil or will combine steam engines and gas turbines. Fuel utilization by railroads will be improved by the use of monorails driven by linear electric motors. Fuel consumption of ships and airplanes could be decreased by new propulsion methods in which surrounding air would become the propulsion jet.

16256

Walker, F. E. and F. E. Hartner

FORMS OF SULFUR IN U. S. COALS. Bureau of Mines, Information Circ., no. 8301, 51p., 1966. 2 refs.

Knowledge of the form in which sulfur occurs in coal is basic in the development of improved sulfur removal methods. Sulfur does not occur as an element in coal, but three sulfur forms in chemical combination are present: combined with the organic coal substance (organic sulfur); combined with iron as pyrite or marcasite (pyritic sulfur); and combined as calcium and iron sulfates (sulfate sulfur). Forms of sulfur are determined on samples of air-dried coal crushed to pass a 250-micron sieve. The sulfate sulfur is extracted from the coal with dilute hydrochloric acid. The pyritic sulfur is extracted from the hydrochloric acid residue portion of the sample with dilute nitric acid. The pyritic sulfur is then determined from the nitric acid soluble sulfur and by calculation from the pyritic iron which is the nitric acid soluble iron. The organic sulfur is taken as the difference between the total sulfur and the sum of the pyritic and sulfate sulfur. A step-by-step procedure for the determinations was presented. Total sulfur and sulfur forms for coal in 283 counties in 29 States and 2 fields of the State of Alaska were determined. Samples totaled approximately 2900 which included most of the coalbeds in the United States. The results were presented in tabular form.

16410

Ochs, Hans-Joachim

DUST AND GASEOUS EMISSIONS FROM POWER PLANTS. (Staub-und gasfoermige Emissionen von Kraftwerken). Text in German. Wasser Luft Betrieb, 12(5):284-288, May 1968. 3 refs.

The pollutants in the stack gases of power plants stem mostly from residues at the combustion of the various types of fuels used in such plants. Operation of such plants with preheated air helps to reduce the emission because fuel is saved. The higher the temperature of the added air, the less fuel is needed and the lower are the pollutant quantities in the flue gases. Three diagrams illustrate this relationship. Recent measurements in the U. S. showed that pulverized coal-fired boilers with dry slag tap-off have, on the average, pollutant concentrations between 5 and 17 g/standard cu m flue gas. A direct relationship exists between the ash content of the used coal and the possible dust concentration. The type of firing system and the composition of the fuel influence the grain size distribution in the flue gas. The ash content of solid fuels and the C-content of liquid fuels are the major sources for solid pollutants. The VDI (Association of German Engineers) guidelines 2091 to 2093 and 2096 to 2098 are concerned with dust emissions by power plants and with means to combat such emissions. An example for the computation of the flue gas flow is given.

16489

Federal Power Commission, Washington, D. C., Bureau of Power

STEAM-ELECTRIC PLANT CONSTRUCTION COST AND ANNUAL PRODUCTION EXPENSES, NINETEENTH ANNUAL SUPPLEMENT - 1966. Federal Power Commission Publ. S-185, 173p., Oct. 1967. 60 refs.

This supplement is the latest addition to the continuous comprehensive record of the operations of important steam-electric plants for the 29-year period 1938-1966. Plant investment costs and the 1966 annual production expenses of 531 plants in the United States and Puerto Rico are detailed in data sheets. Five of the plants are nuclear fueled; 519, fossil fueled. For the first time rural electric cooperatives are reported. The 519 fossil-fueled plants account for 89% of the continental United States' steam-electric generating capacity of 198,341 megawatts and for 95% of the total net generation in 1966. The scheduled capacity of fossil-fueled plants under construction or expansion is 86,000 megawatts in 268 units; that of nuclear-fueled plants on order, 42,000 megawatts in 56 units. Selected references are provided to descriptive articles and papers pertaining to several of the reported plants. Plants are indexed both alphabetically by name and alphabetically by state.

16492

Federal Power Commission, Washington, D. C., Bureau of Power

STEAM-ELECTRIC PLANT CONSTRUCTION COST AND ANNUAL PRODUCTION EXPENSES. TWENTIETH ANNUAL SUPPLEMENT - 1967. Federal Power Commission Publ. S-192, 171p., Nov. 1968. 49 refs.

Data for 537 conventional fossil-fueled steam-electric plants in the contiguous U. S., Hawaii, and Puerto Rico, as well as for seven small, experimental nuclear-fueled plants are reported, accounting for over 95% of the total net generation in 1967. In general, the construction costs per kilowatt of capacity for fossil-fueled plants placed in service during 1967 were higher than for those initiated the previous year. The 1967 annual production expenses, including fuel, increased 0.31 mill per kilowatt-hour over 1966, or 9%. In each of the preceding nine years, these costs had decreased over the previous year. The 9% increase is attributed primarily to increased fuel costs. The 1967 national average heat rate for fossil-fueled steam- electric plants was 10,432 Btu per net kilowatt-hour. About 50% of the expenditures currently being made for the various research and development programs by the electric utilities and their trade associations is going into the nuclear power field, with major emphasis on fast-breeder reactor plants. By the end of July 1968, the total nuclear generating capacity scheduled for service during the period 1968 to 1976, totaled about 60,000 megawatts in 76 plant units. Air pollution, the thermal effects on sources of cooling water supply, and physical appearance of system facilities continued to emerge as major social-economic issues affecting the electric power industry. Technology for removing particulate emissions from power-plants is available; however, the demand for very high efficiency (99% plus) electrostatic precipitators is growing rapidly. Commercial devices for removal of sulfur oxides from flue gases are not yet available.

16722

LaMantia, Charles R. and Edwin L. Field

TACKLING THE PROBLEM OF NITROGEN OXIDES. Power, 113(4):63-66, April 1969. 9 refs.

The National Air Pollution Control Administration (NAPCA), an agency of HEW, is now sponsoring a program to define sources, magnitude, and character of the nitrogen oxide problem, and to consider various methods for the control of NOx emissions from stationary sources. NOx emissions are objectionable because of the brownish color that nitrogen dioxide gives the atmosphere, and also because of their tendency to promote formation of the photochemical smog generally associated with automobile exhaust, resulting in various eye-irritating compounds such as formaldehyde, acrolein, and peroxyacyl nitrates. The sources and emission factors of NOx and various approaches to control, destruction, or removal are discussed.

16788

Foster, P. M.

THE OXIDATION OF SULPHUR DIOXIDE IN POWER STATION PLUMES. Atmos. Environ., 3(2):157-175, March 1969. 12 refs.

Some theoretical estimates are made of the rate of growth of H2SO4 droplets nucleated by MnSO4 crystallites in a humid, SO2 polluted atmosphere. Comparison with experiment suggests that, as the acid concentration within the droplet rises, the rate of growth decreases as a result of the product acid affecting the rate of SO2 oxidation. For this reason the amount of droplet growth, and the amount of SO2 oxidation, is very sensitive to the ambient humidity, and will be greatest for saturated or very high relative humidities where droplet acid concentrations are restricted to low values. Similar calculations relating to the dusty conditions present in power station plumes are also made. These show that the rates of SO2 oxidation observed in these systems can be accounted for by the catalytic qualities of the iron present in the effluent dust. It is suggested that other oxides present also play an important part in this process in that they react with the product acid as it is formed, thus keeping the droplet in a neutral condition in which the catalyst is most active. (Author's Abstract)

16855

Fish, B. R.

RADIATION IN PERSPECTIVE--THE ROLE OF NUCLEAR ENERGY IN THE CONTROL OF AIR POLLUTION. Nucl. Safety, 10(2):119-130, Mar-Apr. 1969. 35 refs.

Nuclear energy can play a critically important role in combating the growing assault on the purity of our atmosphere by supplanting fossil-fuel energy for most of the power plants to be built late in the century. Even then the same tight control that is currently exercised over the nuclear industry must come into being for other industries that are actual and/or potential polluters of the atmosphere. Several air-pollution disasters of the past emphasize the potential for future disasters. (Author's Abstract)

16877

Commins, B. T.

FORMATION OF POLYCYCLIC AROMATIC HYDROCARBONS DURING PYROLYSIS AND COMBUSTION OF HYDROCARBONS. Atmos. Environ., 3(5):565-572, Sept. 1969. 23 refs.

The effect of variations in equivalence ratio (mixture strength) of a combination of fuel vapor and air on the production of polycyclic aromatic hydrocarbons is discussed. The effect of temperature alone on the production of hydrocarbons is studied by pyrolysing acetylene in the absence of air at temperatures in the range 550-1000 C. The ratios of each polycyclic hydrocarbon to 1:2-benzpyrene have been calculated and it is found that certain ratios vary markedly when the combustion conditions are altered. An example is given to show how the proportion of 3:4-benzpyrene contributed to town air by motor vehicles can be calculated in a mixed sample of smoke from motor vehicles and the burning of coal. (Author's Abstract)

16887

Slansky, Cyril M., Henry K. Peterson, and Vernon G. Johnson

NUCLEAR POWER GROWTH SPURS INTEREST IN FUEL PLANT WASTES. Environ. Sci. Technol., 3(5):446-451, May 1969.

The potential radiation hazard connected with the release of Kr-85 from the expanding fuel cycle industry has been studied in detail. One of the main problems in studying this nuclear waste management is estimating the rate of atmospheric dilution of the relatively concentrated off-gas from fuel reprocessing plants. The major variables are: Rate at which the waste is generated (the size of the reprocessing plant), stack height, local meteorology, nature of the terrain, time interval on which the dose is calculated, downwind distance of the perimeter fence around the plant. These factors and the alternative processes for Kr-85 off-gas treatment are discussed.

16888

Day, C. E., Jr.

HOW WE SPECIFY FUELS FOR OUR PLANTS. Combustion, 40(10):22-25, April 1969.

Specifying of fuels and of fuel characteristics, when done cooperatively by engineers and purchasing agents, can be a useful tool for promoting combustion reliability and in obtaining fuel economics. This paper describes how one large industrial fuel consumer specifies fuels to these ends. (Author's Abstract)

16949

Dept. of Interior, Washington, D. C., Office of Coal Research

OFFICE OF COAL RESEARCH ANNUAL REPORT 1968. 56p., 1968.

This report of OCR activities for calendar year 1967 gives detailed attention to the pilot plant program and to anti pollution benefits expected to result from the projects under development. The following pilot plants are described: a flyash brick plant for determining the commercial possibilities of flyash-based structural materials; (2) a plant for using pulverized coal to remove solids and dissolved organic substances from sewage and industrial waste waters; (3) a program to develop coal-fired boilers which use the fluidized-bed combustion process; and (4) a pilot plant for converting coal to gasoline. Various electric power projects are underway to develop a coal-energized fuel cell, a coal-fired electrogasdynamic generator, a coal-fired thermionic topper, and a coal-fired magnetohydrodynamic generator. All have the potential of achieving overall thermal efficiences of 55-60% or more, which would greatly reduce emissions of combustion products, and some of the systems have other beneficial anti-pollution features as well. The group of projects for developing practical methods of converting coal to pipeline quality gas and synthetic petroleum would produce a coal-based fuel able to meet the most stringent air-pollution regulation, since the products must meet the same specifications as natural gas and petroleum for catalytic processing, and would thus have a negligible sulfur content. A number of OCR projects underway or planned are directed toward sulfur removal: the fluidized-bed combustion boiler program, the low-ash coal project, one of the liquid-fuel projects in which sulfur can be removed and recovered from char, and a program to produce low-sulfur boiler fuel using the Consol CO2 Acceptor Process. These are described briefly in terms of their implications for pollution control.

17017

Nikolaev, S. P. and S. A. Dymshits

DISCHARGES OF BOILER OPERATED (COAL BURNING) PLANTS CONVERTED TO GAS BURNING. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:93-96, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

To evaluate the efficiency of shale gas combustion chambers, discharge gases from six chambers were analyzed for sulfur dioxide, hydrogen sulfide, tarry substances, soot, element composition, and caloric value. The SO2 content of the gases ranged from 3.04 to 207.06 mg/cu Nm and the H2S content, from 0.46 to 4.67 g/100 cu Nm of gas. Products of incomplete combustion were CO, H2, and CH4. Tarry substances ranged from 0 to 32.61 mg/cu Nm. The soot present in the gases was in a high degree of dispersion. Caloric value of the gas was 3234 to 3576 cal/cu Nm in the morning and 3178 to 3632 cal/cu m in the afternoon. A statistical study of the data gathered in 19 discharge analyses indicated that incomplete combustion occurred frequently in the chambers. This is attributed in part to faulty chamber construction, inappropriate chamber size, changes in composition and pressure of the gas fuel, absence of control devices, and shortcomings of technical personnel.

17051

Salo, Eric A.

VISIBLE EXHAUST FROM FUEL OILS. Hydrocarbon Process., 49(2):96- 98, Feb. 1970. 1 ref. (Presented to the Air Pollution Control Association, New York, June 1969.)

One possible source of emissions opacity is from the formation of sulfur trioxide, which can form sulfuric acid aerosols on cooling. Tests run with natural gas and controlled injection of sulfur trioxide established an approximate threshold of 24 parts per million of sulfur trioxide for visible sulfuric acid plumes. With the normal rate of conversion in power boilers of the sulfur dioxide formed from combustion of fuel sulfur into sulfur trioxide, the threshold fuel sulfur is about 2 1/2%. This sulfur product is processed from imported stock of unusual composition. Conspicuous to power plant operators is the high pour point which makes it necessary to design a fuel system for a minimum temperature of 130 F or more compared with the common 100 F minimum. Another possible source of emissions opacity is from the formation of sulfur trioxide, which can form sulfuric acid aerosols on cooling. Tests run with natural gas and controlled injection of sulfur trioxide established an approximate threshold of 24 parts per million of sulfur trioxide for visible sulfuric acid plumes. With the normal rate of conversion in power boilers of the sulfur dioxide formed from combustion of fuel sulfur into sulfur trioxide, the threshold fuel sulfur is about 2 1/2%. This supports the policy of specifying a maximum of fuel sulfur of two percent. The problems of conformance and of enforcement of the opacity regulations are due mainly to the fact that opacity is difficult to evaluate with portable instrumentation that inspectors could use.

17052

Viland, Clare Kenneth

AIR POLLUTION AND ATOMIC POWER. Mines Mag. (Denver), 60(1):17, 19-20, 22-23, Jan. 1970.

Some of the facts pertaining to generation of electrical power by nuclear (atomic) energy are presented. Since (1) nuclear power plants are incapable of producing an explosion and radioactive 'fallout', as with a bomb; (2) the reactor fuel, presently mostly 'enriched' natural uranium containing slightly more uranium 235 than found in nature, is completely encapsulated by suitable metals or alloys thereof; and (3) the reactors themselves are enclosed, and heavily shielded to stop gamma rays, which are essentially X-rays, emissions to the air or to cooling water are negligible. Radiation problems to workers are solved by proper use of shielding, observing proper distances, and time of exposure. Radioisotopes can be handled safely by anyone with proper training, facilities, and instrumentation. In the separate centrally-located nuclear fuel reprocessing plants, useful radioactive isotopes are recovered which are finding increasing use in research, medicine, and industry. Oil companies may use iron 59 to measure engine wear and thereby improve lubricating oils.

17184

Shirasawa, Tomiichiro

PUBLIC NUISANCE PREVENTION IN THERMAL POWER PLANTS. (Karyoku hatsudenjo ni okeru kogai boshi taisaku). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 1(1):37-40, April 15, 1965.

Three aspects of pollution by thermal power plants are discussed: smoke emissions; the rise in ocean temperature together with the contamination of sea water by oil discharges and boiler waste water; and operating and construction noise. (1) The present emission standard for sulfur oxides (SO2 + SO3) in smoke dust is below 0.22 ppm in terms of capacity proportion; its dust component is below 1.2 g/cu m in case of thermal power plants. Between 10 and 20 g/cu m of dust is generally present in stack smoke from coal combustion prior to dust collection; this means that coal-fired thermal power plants need to have dust collectors with 90% collection efficiency to meet the smoke emission standard. About three percent sulfur-bearing heavy oil can meet the standard under proper combustion conditions. The boiler cleansing water discharge does not markedly affect ocean temperature, since its initial temperature declines sufficiently in passing through drain pipes before reaching the sewer outlet. In addition, the sewer outlet is of sufficient depth. The amount of chlorine used to protect drain pipes from an encroachment by shellfish is minimal and generally digested by organic components of the cleansing water. Other waste water (acid and alkaline), used for boiler tube washing is discharged after neutralization, settling, or filtering and can not be the reason for water pollution. Leakages of oily waste water occasionally occur during overall inspection of machines or other equipment, but drainage systems associated with an oil distributor tank should be able to collect the oil compounds. The major noise in thermal power plants originates in transformers and ventilators which can make around 100 phon inside a plant, but generally less, and perhaps 60 phon outside. In preparation for future plant expansions, many noise suppression devices will be considered.

17199

Oshio, Toshiki

AIR POLLUTION PROBLEMS IN JAPAN (I). (Wagakuni ni okeru taiki osen to sono mondaiten (I)). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(4):197-208, April 15, 1968.

It is known that air pollution grows more serious where various types of industries are concentrated in one area. The coastal industrial area in Japan is typical in this respect: the recent tendency of plants to locate on, or adjacent to the coastline is particularly reflected in locations of petroleum refineries and petrochemical plants associated with iron and steel refineries or with thermal power plants for whom coastal areas provide shipping advantages. The difficulty of shoreline air pollution control lies in the diversity of industries involved. Factors associated with different pollutants generated by individual plants must be investigated to determine the collective effect of combined pollutants. For example, where heavy oil is burned, the determination of the air-pollution load in the immediate area is based on multiple density, which is the product of the total quantity of exhaust gas emission and respective density of each pollutant. In addition, several major types of effects of the concentration of air pollutants after they leave emission sources should be taken into consideration. Dispersion of pollutants depend on the effective emission height of the chimney, efflux velocity, wind speed, and other geographical conditions which complicate the behavior of atmospheric pollutants in coastline areas. The major sources of sulfurous gases are the thermal power plants, iron-steel refineries, petroleum refineries and petro chemical plants, but there are additional pollutants which make the pollution density thicker. Since sulfurous gas alone may be less important in qualitative and quantitative respects, other combustion products, such as metal sulfides or sulfates generated in iron-steel plants, need to be considered in shoreline pollution abatement programs.

17280

Koutnik, Joseph and Jan Vratny

CONTRIBUTION TO THE PROBLEM OF AIR PURIFICATION IN THE NORTH - BOHEMIAN LIGNITE COAL MINES. (Prispevek k reseni problematiky cistoty ovzdusi v Severoceske hnedouhelne panvi). Text in Czech. Uhli, 11(6):218-221, June 1969. 3 refs.

The changes due to a change of coal with a low content of sulfur during an inversion period was studied at power plants. The climate of a very stable boundary layer was divided into three main types. A very stable boundary layer was defined as one that spreads between the earth's surface at an altitude no higher than 2 km/1,25 miles, characterized with a small positive vertical gradient from the earth's surface to the altitude of 800 m/3200 ft. Individual power plants were evaluated with respect to coal consumption and power. It is suggested that during the period of inversion, as announced by the Weather Bureau, the power plants use the fuel with the lower content of sulfur.

17357

Chovin, Paul

CHEMICAL POLLUTION OF THE ATMOSPHERE. (La pollution chimique de l'atmosphere). Text in French. Sci. Progr. Decour., no. 3417; 35-40, Jan. 1970. 6 refs.

A systematic general review is presented of the origin and nature of chemical pollutants of the atmosphere, of their action on living beings, and of the battle against atmospheric pollution. Principle sources of pollutants are the industrial and domestic heating plants. In regions of high industry concentration, steel plants and chemical plants emit specific pollutants. Principal pollutants are sulfur dioxide, sulfur trioxide, carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, fluorine, and light and heavy hydrocarbons. Sulfur dioxide is a byproduct of combustion of fossil fuels containing, on the average, 3% S (coal in France has about 1% S, some foreign coals have up to 6% S). Estimated emission of S is as follows: in France, 2 million tons, in England, 5 million tons, and in the U. S., 40 million tons a S per year. Sulfur trioxide is largely due to oxidation of SO2; it combines with moisture to form H2SO4 which is very noxious. Rain has a beneficial effect by scrubbing the polluted air. Carbon dioxide is the product of complete combustion of C; 500 to 600 million tons are estimated to be emitted in England. Carbon monoxide is the product of incomplete combustion, rather rare in industry, but invariably present in automobile exhaust gas. Nitric oxide and NO2 are present in low concentrations, but a complex photochemical reaction produces one type of smog, ozone, and new chemical compounds such as peracetylnitrate, CH3-CO-OO-NO2, which has a very strong physiological effect. Fluorine and its compounds, such as HF, are emitted by fertilizer and by aluminum plants. Dusts are emitted by industrial and domestic heating plants. The action of air pollutants on bronchi and lungs is disucssed at length. The reaction of the cardio vascular system and the incidence of broncho-pulmonary cancer are also considered. In the battle against atmospheric pollution laws alone are insufficient, means of measuring emissions, and enforcing compliance are essential.

17398

Council for Air Pollution Countermeasure, Kashima (Japan)

REPORT ON WHOLE INVESTIGATION OF AIR POLLUTION CONTROL MEANS IN KASHIMA AREA, IBARAGI PREFECTURE. (Taikiosen boshitaisaku chosahokokusho. Ibaragiken Kashimachiku). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 6(1):32-38, Jan. 15, 1970.

A field survey was conducted to determine the extent of pollution to be expected following the completion of large-scale industrial projects in the Kashima district of Ibaragi prefecture. The estimated production capacities in the district is as follows: petrochemical plants, 600,000 BSD; thermal power plant, 4,400,000 kw; ethylene products, 1,000,000 t/year; and iron-steel products, 12,000,000 t/year. Each of the industries surveyed has 28 stack plants, 182 boilers and furnaces, and 153 chimneys. The plants consume annually an estimated 7,600,000 kl of heavy oil, which constitutes 75% of the fuel used. The estimated quantity of sulfur dioxide emissions is 20,000 cu nm 3/h, which is lower than that predicted for gross heavy oil burning. The average sulfur content of heavy oil is 1.8%, but if subsidiary fuels, like by-product gas, and oil are included together, the figure decreases by 1.4%. Nearly 86% of the total SO2 emissions from chimneys are discharged from chimneys more than 100 m in height. It is noted that smoke emissions can be controlled by supplying electric power and steam from a central power-station. Factors influencing the dispersion of pollutants, such as geographical features, weather conditions, temperature variation, atmospheric inversion layers, and particularly the occurrence of up and down- air streams, are being investigated.

17418

Fraser, Thomas W. L. Crentz, and A. L. Bailey

HIGH-SULFUR PITTSBURGH COAL: UPGRADING IN SOUTHWESTERN PENNSYLVANIA AND NORTHERN WEST VIRGINIA. Bull Bureau Mines, no. 483, 70p., 1950. 9 refs.

The upgrading of marginal coking coals was studied. Samples were examined from typical areas of Pittsburgh, with principal emphasis on the problem of sulfur. The main washing problem was the removal of sulfur; the removal of ash is relatively easy. The sulfur problem is increased by the wide variations of sulfur content, not only in the raw coal but in the float product. Within the area studied, low-sulfur coal is found which is adaptable to metallurgical use without washing; areas of high-sulfur coal are also found. Within the two extremes, intermediate areas exist that contain some coal matter of metallurgical quality. A study of the washing characteristics of the coals showed that no one method of cleaning will result in a satisfactory solution of the problem of up-grading the high-sulfur coals. Selective mining, low-gravity separation, fine crushing and froth flotation, and combinations of the three must be employed before sulfur can be significantly reduced. All these methods are difficult to control in the practical operation of producing and washing coal. A study of the washability data showed that the raw coal may be classified with respect to ease of cleaning. Coals containing 1.80% sulfur in the raw product present no extraordinary technological problem. Coals containing 1.81 to 2.27% sulfur in the raw state may be upgraded to metallurgical standards by the development and application of intensive preparatory treatment. Coals of the Pittsburgh bed that contain more than 2.27% sulfur in the raw state cannot be considered as a metallurgical fuel. (Author summary modified)

17464

REMARKABLE MEASURES FOR THE IMPROVEMENT OF AIR QUALITY. (Beachtliche Massnahmen zur Verbesserung der Luft). Text in German. Wasser Luft Betrieb, 14(1):33-36, Jan. 1970.

In 1967, a total of 4 million tons of sulfur dioxide were emitted from industrial sources, particularly power plants. Until 1975, an increase to 5 million tons is anticipated; from then on, the SO2 emission will stagnate and eventually decline, due to the use of nuclear power. Contrary to this downward trend, fluorine, chlorine, hydrocarbons and numerous odorous pollutants are on an upward trend, due to the expanding chemical industry. In the metallurgical industry, the sinter capacity has been doubled; thus, the larger units will emit HCl and larger quantities of gaseous fluorine compounds along with SO2. It is estimated that sintering plants presently already emit as much fluorine compounds as the aluminum plants. No fluorine removal method from the waste gases of the ore sintering plants is yet available. Traffic will further increase, as well as vehicle emissions. Emissions by domestic heaters will decrease because electric or central heating will take the place of old coal or oil fired heaters. To combat the increasing pollution of air by an overall increase of emissions, the state of North-Rhine-Westphalia plans to establish emission inventories. Such inventories have been made in the area around Cologne; other large cities will soon follow.

17483

Rivera-Cordero, Antonio

THE NUCLEAR INDUSTRY AND AIR POLLUTION. Environ. Sci. Technol., 4(5):392-395, May 1970.

Sources of air pollution from nuclear industry processes are reviewed. Studies indicate that radioactivity from a nuclear power reactor is at least comparable to, if not lower than, that released by a fossil-fuel burning plant of similar size, and the safe operation of nuclear reactors with respect to air pollution has been demonstrated; however, nuclear fuel processing is a more important source of environmental radioactivity than the reactor itself. About 99.9% of all nuclear wastes arise through the reprocessing of reactor fuel, because of the enormous amount of radioactivity in spent fuel. The gases evolved from a fuel processing plant are usually contaminated with such chemicals as nitric acid and organic solvents, as well as with fission products; but the release of 85Kr to the atmosphere is probably the most critical air pollution problem in the industry. Applicable control processes for emissions from the various nuclear processes are noted. Projects such as 'Plowshare' may represent an important source of air pollution in the future, if nuclear explosives are used for mining, excavation, and ore processing. Meteorological analysis can be used to reduce nuclear process air pollution, especially since continuous discharge is frequently unnecessary and gases can therefore be stored for radioactive decay until weather conditions are favorable for dilution and dispersion. Nuclear technology has made positive contributions to air pollution science in recent years with the development of various tracer techniques and monitoring instruments.

17542

Takahashi, Kanji

ENVIRONMENTAL POLLUTION DUE TO ATOMIC ENERGY DEVELOPMENT. (Genshiryoku kaihatsu ni tomonau kankyoosen). Text in Japanese. Doboku Gakkaishi (J. Japan Soc. Civil Engrs.), 55(2):41-42, Feb. 15, 1970. 5 refs.

The release of radioactive substances from atomic power plants in the U. S. is discussed with reference to protecting the environment against radioactive contamination. Control measures center on the diluted low-level waste, the radioactivity of which is only a fraction of that of total radioactive substances. These radioactive substances are mainly nuclear fission products generated by nuclear power plants; their release to the atmosphere is accompanied by the release of radioactive air-cooling and corrosive substances. Concerning radioactive substances in the air and drinking water, the maximum density of over 200 kinds of nuclei is restricted by law. Similarly, restrictions are placed on the amount of radioactive wastes that can be emitted by a plant. Air pollution by atomic power plants is less than that by thermal power plants. However, atomic power plants release considerable quantities of tritium. Fortunately, tritium is not particularly hazardous, and tritium emissions will not be an important air pollution problem in the near future. However, consideration must be given to its long half-life.

17688

Sullivan, Ralph J.

PRELIMINARY AIR POLLUTION SURVEY OF ARSENIC AND ITS COMPOUNDS: A LITERATURE REVIEW. Litton Systems Inc., Silver Spring, Md., Environmental Systems Div., Contract PH 22-68-25, NAPCA Pub. APTD 69-26, 60p., Oct. 1969. 89 refs. CFSTI: PB 188071

Arsenic and its compounds are known to be toxic to humans, animals, and plants. Arsenical dusts may produce dermatitis, bronchitis, and irritation to the upper respiratory tract. Medicinal ingestion of arsenic has produced keratoses and cancer of the skin. The relationship of arsenic to other types of cancer, particularly lung tumors, is uncertain. Arsenic is produced by smelters processing arsenical ores. Because there is no economic incentive to remove arsenic from the exhaust fumes of smelting, the smelter is a potential local pollution source. Arsenical compounds are used as insecticides and herbicides. The use of arsenic in pesticides has declined since the appearance of organic pesticides. The largest quantity of arsenic is used as a desiccant for cotton prior to machine picking. As a result, arsenic pollution occurs during cotton ginning and the burning of cotton trash. Coal also contains a small amount of arsenic; thus, city air contains a small amount of arsenic given off by combustion of coal. The 1964, average daily concentration was 0.03 micrograms/cu m. In general, the removal of particulate material will control arsenic emissions if the control equipment operates at approximately 100 C to condense the arsenic fumes. An electrostatic precipitator is reported to reduce the arsenic from 5-17 ppb to 0-4 ppb. Precipitators, cooling flues, and bag houses are used in the smelting industry. At a chemical plant in the U.S.S.R., arsenic removal reached 100% efficiency after wet vacuum pumps were substituted for fabric filters. Methods of analysis are available for measuring ambient air concentrations of arsenic. (Author abstract modified)

17910

Dumont, A. H. and J. L. Guiette

ENERGY PRODUCTION UNITS OF THE 'TURBO-JET' TYPE. (Les groupes de production d'energie du type 'turbo-jet'). Text in French. Bull. Soc. Roy. Belge Electriciens, 85(1):21-37, Jan.-March 1969. (Presented at the Societe royale belge des Electriciens a Bruxelles, Jan. 23, 1969.)

A brief, general description is given of 20- and 40-megawatt electric power stations using turbo-jet type aviation gas turbines with direct-driven alternators, installed at Langerbrugge (Belgium) and at Beerse (Belgium) respectively. Schematic sectional views and photographs of the exterior views of these stations are shown. The environmental problems posed by the turbo-jet units are discussed, as well as their typical applications. The electrical control circuits and the operational characteristics of the turbo-jet electric power stations, the economic aspects of their use, as well as their applications as back-up units in electrical networks, emergency power units, and as a 'cold reserve' in electrical installations are presented. The environmental aspects considered in detail are acoustical vibrations, mechanical vibrations, and smoke emission. As these power stations are located in residential districts, the above factors are highly important. High-frequency noise is generated in the compressor stage by the motion of the rotor blades past the stator blades and emerges largely through the air intake. Low-frequency noise is generated in the combustion chamber and high-frequency noise, from the gas turbine emerge through the gas outlet. High frequency sound is emitted by the housing of the unit. The elaborate sound absorption measures are described and the vibration-isolating mounting of the unit are discussed. When natural gas is used as fuel, no smoke is formed. Light virgin naphtha used in Belgium gives less smoke than kerosene. Changes in existing combustion-chamber designs resulted in reduced smoke emission.

18052

Chironis, Nicholas P.

SMALL STEAM ENGINE VIES FOR CARS, POWER PACKAGES. Prod. Eng., 40(7):100-102, April 7, 1969.

Many engineers feel the steam engine is a potential replacement for the air-polluting internal combustion engine. It is relatively simple, silent, efficient, produces fewer pollutants, and it can use cheaper, safer fuels than can other engines. A V-4 steam engine that weighs less than 40 lb and is so simple it needs no castings is powering motorboats and being adapted for use in medium-sized vehicles. Moreover the engine is proving remarkably successful as the power source for compact, steam powered, total-energy modules. The total-energy package is described in some detail with flow sheet and phase diagram.

18056

Glaser, Peter E.

POWER FROM THE SUN. Mech. Eng., 91(3):20-24, March 1969. 16 refs.

The projection of energy requirements vs fossil fuel availability shows that within a few hundred years other energy sources will be needed. Solar energy, perhaps gathered and focused by satellites, is one of the sources of energy that may become increasingly important. Some of the features of a satellite system are discussed. Based on present state-of-the-art of solar photovoltaic conversion devices there is little likelihood that the efficiency and cost per unit weight and per unit collector will be attractive enough to be used for converting significant amounts of energy with a satellite system. An entirely different type of material for solar energy conversion, organic semiconductors, are discussed. Problems of power generation and transmission, and of earth receiving stations are discussed briefly.

18078

Seaborg, Glenn T.

LOOKING AHEAD IN NUCLEAR POWER. Mech. Eng., 91(8):30-34, Aug. 1969.

With the prospect of increased future requirements for electrical energy it will be important to utilize all fuel sources wisely and effectively. Current AEC studies are being conducted to examine all aspects of nuclear energy systems--future power requirements, economics, conservation of resources, reactor technology, safety, and the public interest. Various kinds of breeder reactors are being investigated. The economic advantages that might accrue from a strong program for the development of breeder reactors were brought out by a report, 'Cost-Benefit Analysis of the U. S. Breeder Reactor Program,' completed recently by the AEC. Environmental factors play an important role in the assessment of the nuclear energy program. Air pollution, thermal pollution, and radioactive discharge are factors that must be kept under control but at a rational level not a level dictated by public hysteria.

18114

McCartney, J. T., H. J. O'Donnell, and Sabri Ergun

PYRITE SIZE DISTRIBUTION AND COAL-PYRITE PARTICLE ASSOCIATION IN STEAM COALS. CORRELATION WITH PYRITE REMOVAL BY FLOAT-SINK METHODS. Bureau of Mines, Washington, D. C., Rept. Invest. 7231, 18p., 1969. 18 refs.

In an effort to correlate the size of pyrite particles in coal and coal-particle association with the removal of pyrite before burning, the Bureau of Mines conducted a study of 61 coals presently being used for electric power production. The results were obtained by visual microscopic studies of polished briquets of minus 14-mesh samples. Mean pyrite particle sizes ranged from 20 to 400 microns and proportions of pyrite contained in coal particles to an extent greater than 50% by volume (estimated) ranged from 20 to 95%. These parameters were correlated with reductions in pyrite accomplished by float-sink tests at 1.60 sp gr on 14-mesh, 3/8-inch, and 1-1/2 inch samples. The correlation coefficients between pyrite removal and mean pyrite particle size were 0.89, 0.84, and 0.79, respectively, for these samples. Correlation coefficients between pyrite removal and coal-pyrite association parameter were 0.92, 0.90, and 0.85, respectively. It is apparent that extent of pyrite removal can be fairly well predicted from microscopic analysis. (Author's Abstract)

18171

Thiessen, Reinhardt

OCCURRENCE AND ORIGIN OF FINELY DISSEMINATED SULFUR COMPOUNDS IN COAL. Trans. AIME (Am. Inst. Mining, Metallurgical, and Petroleu Engr.), p. 2431-2444, 1919. 9 refs.

All coals that have been examined microscopically contain disseminated microscopic grains of pyrite. These are distributed very irregularly and usually occur in colonies. Different coal seams vary in the total content of this form of pyrite, different horizons differ in the total content, and different parts of a section may vary widely in the number of globules present. The majority of globules are roughly spherical in form with a rough surface, and readily break into numerous minute cubes. Coals also contain submicroscopic sulfur, probably as organic sulfur. Although the presence of organic sulfur has been known for a long time, its chemical form is not known. Plants contain sulfur in two forms: as a component of proteins and as non-protein sulfur. The sulfur in proteins is universally present in plants, while the other form occurs only in certain families, but in some of these it occurs in relatively large amounts. On decomposition, the sulfur in plants is released mainly as hydrogen sulfide. Sulfur is absorbed by higher plants as a sulfate; hydrogen sulfide is toxic and must first be oxidized to a sulfate. Hydrogen sulfide may be oxidized through the agency of sulfur bacteria, resulting in sulfates. All plant ashes contain some sulfur. Sulfur is present in peat bogs from 0.29 to 4.21%. Calcium sulfate often crystallizes out when peat is dried slowly. Peats contain pyrite in the form of microscopic grains, similar to those found in the lignites, sub-bituminous, and bituminous coals. (Author summary modified)

18176

Dillard, J. K., and C. J. Baldwin

UTILITIES SEEK TO OPTIMIZE ENERGY ECONOMICS. Elec. Light Power, p. 84-87, April 1965.

Present trends indicate that there will be increased usage of mine-mouth plants, EHV transmission, and nuclear generation. Pooling will take place on a regional basis with an upper limit of transmission distance of 500 to 700 miles. Economies will be realized by locating a large portion of the installed capacity relatively near the load centers. Large nuclear plants will be applied in areas with fuel costs in excess of $0.25 per million Btu. Competition from nuclear plants and regional mine-mouth plants will exert continued downward pressure on coal costs and rail rates. Studies of the economics of pooling have shown savings from common economic dispatch and two-way energy transfer that have amounted to about 3% of the total fuel bill and investment charges on the bulk power systems of the pooling utilities. The trend toward larger plant sizes has helped to establish a competitive advantage for nuclear power where fuel costs exceed $0.25 per million Btu, since these plants enjoy an economy of scale beyond that of conventional plants. The slightly higher initial cost of nuclear power plants is offset by the progressively lower fuel-cycle costs encountered. The distances over which pooled power blocks can be economically transmitted depends on the type of generation, plant size, the line voltage used, and fuel costs in the relative areas. Fuel cost vs transportation distance curves are shown. Several practical examples of economical pooling are given.

18177

Gerber, Abraham, and Bruce C. Netschert

THE ENERGY OUTLOOK FOR THE UNITED STATES. IEEE (Inst. Elec. Electron. Engrs.) Spectrum, 6(6):38-45, June 1969. 6 refs.

Prevailing trends in U. S. energy production and consumption are reported, and statements are made concerning the outlook for the future. Total energy consumption in the U. S. grew at an average rate of 4.3% in the period of 1961-1966. Rate of growth for consumption of fuels for the production of electricity was 7.3%. Fossil fuels are to continue to be the main source of fuel for electricity with an increase of 3.1%/yr. in the rate of consumption. Nuclear fuel is beginning to emerge as a competitor of fossil fuels, but it is not possible to predict its likely impact on the consumption of fossil fuels in the next two decades. Sources of all fuel types are discussed. Air pollution resulting from energy production is discussed. One of the most important issues is industrial SO2 emission, and the legislation dealing with this emission. Control by desulfurization of fuels, higher stacks, and removal of SO2 from flue gases is discussed. The impact of measures to abate air pollution on energy consumption in the near future cannot yet be forseen.

18276

Evans, R. K.

WORLD FUEL RESOURCES. Power, 112(6):S6-S11, June 1968.

Fuel reserves and new ways of converting them into usable energy are constantly being discovered. During the past 20 years, more than 364 trillion cu ft of natural gas reserves have been proved in the U. S. Proven reserves of crude oil in the world were estimated at 500 billion barrels by the end of 1967. To fuel the growing number of nuclear power plants, 100,000 tons of uranium will be needed by the end of 1972. The bulk of the known worldwide reserves of uranium are located in the U. S., Canada, and South Africa. It is difficult to estimate how much of a country's coal resource is economically recoverable. According to the U. S. Geological Survey, our recoverable coal reserves amount to 830 billion tons, a 1500-year supply at the present rate of consumption. Most coal seams in the U. S. are more accessible, substantially thicker, and more horizontal than deposits in other countries, which allows our mines to develop faster and at lower cost. By-products and refuse are also valuable fuel resources.

19017

Johnstone, H. F.

REACTIONS OF SULFUR COMPOUNDS IN BOILER FURNACES. Ind. Eng. Chem., 23(6):620-625, June 1931. 12 refs. (Presented at the American Chemical Society Meeting, 81st, Indianapolis, Ind., March 30- April 3, 1931.)

In a furnace, the sulfur in coal is converted mainly into sulfur dioxide. Only about 2% is oxidized to the trioxide, regardless of the temperature or oxygen content of the gases. The concentration of sulfur trioxide in the stack gases is no greater, therefore, than that in the furnace gases. Flue dust has only slight catalytic action in the oxidation of sulfur dioxide. When the sulfur in the fuel exists as sulfuric acid, as, for instance, in petroleum residues, about 85% of the acid is reduced in the furnace to sulfur dioxide. The gases contain only slightly more trioxide than those from high-sulfur coal. When coal is fired on a stoker, about 30% of the sulfur remains in the ash, at least a part of which exists as iron sulfide. Particles of dust containing the sulfide adhere readily to one another and to metal surfaces, so that hard deposits build up readily both on boiler and economizer tubes. On boiler tubes, most of the sulfur in the slag is lost by oxidation of the sulfides and decomposition of the sulfates. At lower temperatures, the sulfates are stable and the slag contains a large proportion of sulfate sulfur, even above the condensation temperatures of the gases. Concentrations of sulfur trioxide in the gases as low as 0.015% raise the dew point to 80-100 C. The hygroscopic nature of deposits containing ferric sulfate also causes moisture to condense at temperatures considerably above the dew point of the gases calculated from the partial pressure of water vapor in the gases. As solutions containing ferric sulfate act as strong catalysts for the oxidation of sulfur dioxide to sulfuric acid, the existence of these sulfates in the flue dust is responsible for an increase in the temperature range of corrosion by flue gases. Increased moisture content of the gases caused by leaks or by the use of steam soot-blowers will produce the same effect. (Author abstract)

19024

Dicks, John B., Jr.

LARGE SCALE POWER DEVELOPMENTS. Tennessee Univ., Tullahoma, Space Inst., AFOSR Contract F44620-69-C-0031, 14p., 1969. 3 refs. CFSTI, DDC: AD 701446

The engineering problems, economics, pollution aspects, and feasibility of technically advanced large-scale central power plants are discussed. Particular emphasis is given to magnetohydrodynamics (MHD) topping of conventional steam plants. MHD power generation is achieved when an easily ionized metal such as potassium or cesium is introduced into high-temperature combustion gas which is expanded to high velocity and directed into a magnetic field with properly arranged electrodes and an external circuit. The principle loss in overall power plant efficiency, currently less than 40%, arises in the heat cycle. The steam cycle used only a relatively small portion of the available temperature range, and a much more efficient cycle might operate by topping the steam cycle with a device that could operate at the flame temperature or above. In the MHD cycle, an increase in flame temperature is necessary to produce the required electrical conductivity. In such a hybrid, the conventional power generating stage would supply less than 50% of the power. The seed material that is contained in the effluent is expensive enough that particulate and vapor removal from the exhaust gas would be mandatory. Overall efficiency of the steam/MHD system lies between 50 and 60%. The cost of nuclear produced electric power has increased from 112 dollars/kilowatt to 160 dollars/kilowatt in the last few years. A comparison of economics for conventional coal-fired, nuclear boiling water reactors, and coal MHD steam systems indicates a possible savings of 70 billion dollars between now and the end of the century through the development of MHD-topped steam plants. The cost of development would be high, probably involving 237 million dollars in order to get through the construction of the first large-scale plant producing 1000 megawatts.

19038

Strimbeck, Donald C., Arthur J. Liberatore, Gerald B. Goff, and James P. McGee

BUREAU OF MINES COAL-FIRED GAS TURBINE RESEARCH PROJECT. TEST OF COMBUSTOR AND ASH SEPARATORS FOR OPEN-CYCLE PLANT. Bureau of Mines, Washington, D. C., Rept. of Investigations 7295, 12p., Sept. 1969. 2 refs. CFSTI: PB 187742

A down-fired combustor lined with refractory brick proved to be an efficient means for burning pulverized coal in an experimental open-cycle gas turbine. Efficiency of the combustor was 95 to 99+ % (compared with 85-90% for the previously used flame-tube combustors) as a result of better mixing of air and coal in the combustion zone, longer retention time of coal in the burning zone, and lower heat loss. Relatively little unburned carbon remained in the ash, thereby reducing the mass load of solids requiring removal; 20% of the particles were removed from the washout chamber at the bottom of the combustor. The axial-flow separator operating as a single stage adequately met design specifications calling for low pressure drop and little gas blowdown loss, while ash load in gas from the axial-flow separator was about 24 grains/100 scf. Although the objective of improving the ash separation was not achieved, the experience indicated that an ash concentration around 1 grain/100 scf might prove acceptable. (Author conclusions modified)

19084

Laufhuette, D. W.

PRACTICAL EXPERIENCE WITH DUST RECORDERS FOR CONTINUOUS MONITORING OF DUST EMISSIONS. (Betriebliche Erfahrungen mit registrierenden Staubmessgeraeten zur Daueruebenwachung von Staubemissionen). Text in German. Mitt. Ver. Grosskesselbesitzer, 49(1):15-23, Feb. 1969. 2 refs. (Presented to the VGB, Emissions Meet., Salzburg, Bielefeld, and Saarbruecken, 1968.)

Performance of dust measuring apparatus behind hard coal-fired boilers in power plants was tested, with the use of electroconductivity analyzers and transmissometers. Parallel gravimetric measurements were taken for comparison, while operating the boiler at a constant load of 110 tons steam/h for the entire test period. The same type of coal was used for all tests. Electroconductivity analyzers were found to operate reliably only at constant load, and to be incapable of adjusting to changing boiler loads with varying speeds and dust distributions. Dust was deposited between the sampling probe and the dust sensor, even when the heater was used to avoid below dew point temperatures. The ionization tube tended to be worn through friction of the dusts. Measurements were falsified through dust deposition in the return duct from the dust sensor to the cleaned gas duct. A correlation of the photometric measurements and the specific dust content existed, but a transfer of the found correlation to other similar plants was not feasible. Only the latter method was found to be suitable within certain limits (constant load etc.) for continuous dust monitoring in boilers.

19165

Felix, R.

INDUSTRIAL ELECTRO-HEAT APPLICATIONS AND AIR POLLUTION. (Les applications electrothermiques industrielles et la pollution de l'air). Text in French. Preprint, Union Internationale de l'Electrothermie, Paris, 5p., 1966 (?).

Arguments for and against the increased use of electric heating in industry are discussed. The main objections are that many plants where electric heating and power are used still give off fumes, and that the power plants from which the electric power is derived are themselves sources of pollution. Concerning the first argument, it is pointed out that some plants, such as those for the making of aluminum and calcium carbide, cannot use other forms of power and can therefore not be compared. In cases where electric heating is one of several alternatives, the electric power does not in itself create pollution problems that do not exist when other heat sources are used. With respect to the problems of electric power plants, it is noted that substantial progress has been made in developing nuclear sources of power, reducing the sulfur content of fuel oil and coal, in providing higher chimneys for the dissemination of waste gases, in using recovery equipment for exhaust gases, and in locating power sources at greater distances from population centers.

19318

Walterscheid, Edward C.

NUCLEAR POWER. Analog Sci. Fiction/Sci. Fact, 86(1):32-69, Sept. 1970.

Similarities and differences between nuclear and fossil-fueled electric power plants are discussed. The chief similarity is their inefficiency. Fossil-fueled plants can achieve net efficiencies of 38-40%; light-water-reactor nuclear power plants now in use in this country achieve a net 32%. Power plants, fossil or nuclear-fueled must dissipate a tremendous amount of heat to their surrounding environment. In a fossil-fueled plant, about 15% of the heat input is lost through the stacks, boilers, turbines, and for station use. There is no stack loss in a nuclear plant and other inplant losses amount to 5%. The remainder of the heat is dissipated to the atmosphere through condensers which can require large amounts of cooling water. In passing through the condensers, the cooling water is heated 10 to 20 degrees or more depending on plant design. Almost 1/3 of all the water used in the United States is used as cooling water for these plants. Both nuclear and fossil fueled plants produce certain waste products which must be dealt with. The wastes from fossil fueled plants are considered air pollutants and consist primarily of fly-ash and gaseous oxides of sulfur, nitrogen, and carbon. Carbon dioxide is being added to the atmosphere at a rate of 6 billion tons a year by the burning of fossil fuels. The problem associated with wastes from nuclear power plants is radioactivity. However, from a biological point of view, more radioactivity is released to the environment by operation of a large fossil fueled power plant than by the equivalent sized nuclear power plant. This release is in the form of several isotopes of radium present in coal and oil which are emitted to the atmosphere in fly ash. While this does not constitute the formation of new radioactivity such as occurs in a nuclear power plant, it does have a similar effect on the environment. It is, however, in the formation of new radioactivity that the future promise of the nuclear power plant lies. Reactors have been designed that create more nuclear fuel than they use. When the dwindling reserves of fossil fuels are considered, these nuclear 'breeder' reactors look like the best available means of meeting the projected requirement to quadruple or quintuple our generating capability by the year 2000.

19434

Ministry of Labour and Social Welfare, North Rhine-Westphalia, Germany

KEEPING THE AIR PURE IN NORTH RHINE-WESTPHALIA. (Reinhaltung der Luft in Nordrhein Westfalen). Congr. Reinhaltung der Luft, Duesseldorf, West Germany, 1969. (Oct. 13-17.) Translated from German. Belov and Associates, Denver, Colo., 133p., Feb. 11, 1970.

The centers of industrial concentration in North Rhine-Westphalia are also those of population concentration. The close juxtaposition of these concentrations of emittants of air pollutant material and the densely situated population causes extreme problems. The directed measures of the last ten years against the unbearable dust load and the harmful sulfur dioxide emissions have led to considerable improvements. Measurements show an extraordinary reduction of dust and SO2 in the air since 1963. While infringements on the dust limit values were found on 22% of the measurement surface at the beginning of the measurement period with 5% of the measuring surface violating the SO2 limit value, in the year 1968 violations were 5% for dust and 1% for SO2. These successes were predominantly due to severe licensing practices for new industrial plants and improvement programs for existing industries that do the most to determine emission concentrations: steel convertors, ore sintering plants, coking furnaces, foundries, and steam power plants. The experiences of the last few years have shown that the problems of air pollution are subject to change and have a continuous connection with the developments in technology and production in industry. An increase of around 25% to 5 million tons SO2 emissions per year is projected from 1967 to 1975. From 1975 on, the production of electric power, which will then account for 40% of the SO2 emissions, will be considerably influenced by atomic energy; SO2 emissions will first stop their increase and then start to decline. Fluorine, hydrocarbons, chlorine, and numerous odor substances will become the focus of attention. The dust problem will no longer be a question of loads due to coarse dust, but dangers to health due to fine dusts. Precipitation measurements will be extended to include concentration measurements. In the coming 10 years, the State will also take an increasingly critical look at emissions from automobiles and domestic heating units. The goal of the State Government is the development of a control system on a regional basis. Data banks will be set up to provide regional data on individual industrial emission sources, as a tool to the development of control programs. This program has already begun in the area of metropolitan Cologne and will soon be extended to the Duisburg/Oberhausen/Mulheim a.d. Ruhr, Essen/Bottrop, Gelsenkirchen/Wanne/Eicket/Bochum, Castrop/Rauxel, and Dortmund regions.

19444

Juentget, H. and K. H. Van Heek

PROGRESSES MADE IN THE RESEARCH OF PYROLYSIS OF BITUMINOUS COAL. (Fortschritte der Forschung auf dem Gebiet der Steinkohlenpyrolyse). Brennstoff-Chem. (Essen), 50(6):172-178, June 1969. 63 refs. Translated from German. Belov and Associates, Denver, Colo., 28p., May 12, 1970. (Presented at the DGMK Annual Meeting, Salzburg, Germany, Oct. 7-9, 1968.)

Research is reported which deals with new work in the field of coal decomposition at high temperatures (up to 10,000 K), the state of the knowledge pertaining to reaction kinetics of the gas formation during thermal decomposition of coal, and the correlation between bituminous coal analysis and combustion. Through the development of high-energy plasma burners and lasers, experimenters can now perform the thermal decomposition of coal using extremely high temperatures and correspondingly high heating rates. Additionally, differentiating physical instruments for the determination of the products of pyrolysis, new methods for the evaluation of measured data by the use of computers, and new techniques for the heating of coal samples facilitate exact studies of the reaction kinetics of the gas formation during pyrolysis. Discussion is presented pertaining to the thermodynamics of coal at high temperatures, the kinetics of coal pyrolysis, and the correlation of pyrolysis with other reactions occurring during the combustion of individual coal particles.

19511

Biederman, Nicholas P.

CAN NATURAL GAS HELP US SURVIVE ON A POLLUTED PLANET? Pipeline Gas J., 197(8):46, 48, 50, 52, 54, 56, 59, 60, 62, and 64, July 1970. 16 refs.

The role of the natural gas industry in terms of the overall pollution problem is discussed. The most beneficial use of the existing supply of natural gas is considered. The areas of air, water, solid waste, and noise pollution are reviewed from a historical perspective through to present problems. Classification of pollution sources and emissions are given, as well as costs of control programs, particularly in fuel substitution and fuel emission control. Domestic pollution, municipal and industrial waste, and thermal pollution are considered. Electric power generation is the largest source of thermal pollution. Even with the total potential reserves, the gas industry cannot supply fuel to everybody in unlimited quantities. It is essential that government, industry, and individuals cooperate to insure that natural gas is used beneficially, rather than simply conveniently.

19994

Miner, Sydney

PRELIMINARY AIR POLLUTION SURVEY OF RADIOACTIVE SUBSTANCES: A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., NAPCA Contract PH 22-68-25, Publ. APTD 69-46, 143p., Oct. 1969. 199 refs. CFSTI: PB 188092

Radiation effects on humans are of 2 types: biological (leukemia, cancer, shortened life span) and genetic, which is difficult to assess. Thus far, the radiation reaching the general public as a result of the nuclear power industry is insignificant compared with that from natural sources (radioactive minerals in the earth and cosmic ray activity), although the proposed expansion of the industry could give rise to problems from krypton-85. The nuclear weapons testing programs temporarily raised radiation levels 5-10% higher than those of natural sources. Maximum permissible concentrations for radionuclides released from nuclear plants have been set by the Atomic Energy Commission. The cost of control procedures used in the nuclear industry amounts to about 10% of the total cost of the plant. No data is presently available on the cost of damage from radioactive pollution of the atmosphere, but the atmospheric concentrations of radioactive substances can be determined by a number of highly accurate, sensitive methods. These include such sampling methods as filters, impactors, impingers, and settling trays. Particulate samples can be analyzed for activity and particle size. Among the radioactive gases analyzed are iodine, tritium, argon-41, krypton-85, xenon-133, xenon-135, carbon-14 dioxide, and sulfur-35 dioxide.

20736

Bennett, Raymond R.

ENERGY FOR THE FUTURE. Combustion, 41(10):8-12, April 1970. (Also Ebasco News, 22(8).)

Electrical generating requirements for the next 25 years are forecast and the various sources of raw energy are analyzed to obtain an estimate of their proportionate applicability during that period. It is predicted that coal will lose its high percentage of the market but will still provide a significant quantity of the raw energy requirements. Generation by natural gas will grow at a much slower rate than in the past, due to competition from other consumers and a limited proven reserve. Oil will provide energy to coastal utilities but will be limited to coastal areas by transportation costs and will not be a dominant energy source. Hydro will diminish in importance and areas now predominantly hydro will turn to nuclear and coal in the future. Nuclear energy will achieve a dominant role in electric utility generation.

20863

Gambs, Gerard C.

THE ELECTRIC UTILITY INDUSTRY: FUTURE FUEL REQUIREMENTS 1970-1990. Mech. Eng., 92(4):42-48, April 1970.

By 1990, the thermal generating capacity of power plants will have increased from 270 million kw in 1970 to over 1100 million kw. The generation of electricity in 1990 will be four times the 1970 generation, and the total fuel requirement by 1990 will be nearly five times that of the current level. The types of fuel which will be consumed in the 1970-1990 period are discussed. Due to anticipated shortage of coal, comsumption of coal by electric utilities will peak out at 315 million tons by 1975 and then decline to 226 million tons by 1990. Because of the availability of oil, and the cost advantage of burning oil instead of coal, oil consumption will grow from the current level of 250 million bbl per year to 644 million bbl per year by 1990. Current consumption of natural gas is now about 3000 billion cu ft per year and should continue to increase to 6100 billion cu ft per year by 1990. Hopefully, nuclear shots for gas stimulation will increase gas reserves. It is believed that nuclear power will grow from the current level of several million kw to nearly 200 million by 1980 and to 600 million kw by 1990. The advantages of utilizing uranium ore as a fuel is indicated by the fact that it takes 17000 tons of coal to equal one ton of uranium oxide concentrate in energy equivalent.

21191

Sakagishi, Shokichi

ENVIRONMENTAL SECURITY. (Kankyo no anzen). Text in Japanese. Genshiryoku Kogyo, 16(4):129-132, April 1, 1970.

In view of the anticipated growth of nuclear power plants, protection of the environment for both plant workers and residents of surrounding areas must be insured. The major procedures followed by the Atomic Energy Commission of Japan to evaluate environmental security around an atomic plant are as follows: (1) inspection of the dispersion of radioactive substances to the atmosphere by the Pasquill method, which is not applicable to gamma radiation and (2) inspection of discharged waste water to determine if it meets present emission standards. At the present time, the effect of sea water or streams in diluting waste water and the waste concentrations in marine products are unknown, as is the cumulative effect of the wastes on human health. A recent report by the Commission indicates that emission rates of radioactive contaminants contained in wastes are more important than total emission levels. This means that, even when emission levels are low, wastes should be discharged only when the radioactive contaminants are subject to the constant possibility of irradiation through direct effects as well as through the indirect one of the food chain. It is recommended that the emisssion rate before discharge be measured by an authorized body and that the effect of mass emissions from all plants in the area of an atomic energy plant be checked. Since the accidental release of radioactive substances from plants already in operation or under construction appears to be minimal, the remaining security problem is the location of the treatment facility for solid wastes.

21204

Hals, Finn A.

ENVIRONMENTAL POLLUTION CONTROL THROUGH MHD POWER GENERATION. Combustion, 41(11):27-29, May 1970.

In addition to offering advances in power technology of significant benefit to society, magnetohydrodynamics (MHD) shows promise of solving serious air and thermal pollution problems faced by steam-electric power plants. The use of MHD-steam power plant could significantly reduce thermal pollution of water since, due to higher efficiencies, less than half the amount of cooling water used by conventional fossil-fueled steam power plants would be required. Since the supplemental steam turbine can be replaced with a supplemental gas turbine, MHD generators can be designed to reject all heat into the atmosphere and none to water. With no cooling water necessary, MHD generators can be located in water-poor but fuel-rich areas, opening them to industrialization. Particulate emission would be controlled by careful electrostatic precipitation, since the economic operation of the plant requires the recovery of an alkali seed impurity added to enhance electrical conductivity of the combustion gases. Particulate removal in excess of 99% is, therefore ensured. The temperatures at which MHD generators operate make the recovery of nitrogen oxides and sulfur oxides in the form of nitric and sulfuric acid technically feasible and economically attractive.

21221

Fels, M. and H. L. Crawford

FEASIBILITY STUDY OF CENTRALIZED AIR-POLLUTION ABATEMENT. (FINAL REPORT). Battelle Memorial Inst., Columbus, Ohio, Columbus Labs. NAPCA Contract PH-86-68-84, TAsk 12, 51p., Nov. 17, 1969. 35 refs. CFSTI: PB 190486

The technical and economic aspects of a centralized air-pollution control plant located a distance from seven industrial plants were investigated. The plants chosen were as follows: lime, 200 tons/day; cement, 4500 barrels/day; sulfuric acid, 400 ton/day; power, 25 Mw; fertilizer, 570 tons/day; gray iron, 1440 tons/day; and electric arc, 2600 tons/day. Gaseous and particulate-emission levels were taken from literature sources, and as far as possible, average values were used for each industry. The total amount of gases from the plants was 627,000 cfm at 320 F and after mixing. While the centralized control facility is less expensive to build and operate than individual control devices, transportation costs are so high as to make the centralized concept unattractive. The economics would favor centralized abatement only if each of the seven plants were located at about 1/2 mile from the central facility. This distance is considered to be unrealistically close from the standpoint of an individual plant's land requirements. In addition to transportation costs, the centralized plant would render emissions from lime, cement, and sulfuric acid plants valueless, and any equipment malfunction would release large quantities of pollutants over a relatively small area. Finally, vegetation growth over buried pipes would be inhibited, leading to potential esthetic problems. (Author summary modified)

21286

Marquardt, W., R. Hoehle, and U. Schuh

RADIOACTIVE EMISSION BY COAL-FIRED POWER PLANTS. (Radioaktive Emissionen durch Kohlekraftwerke). Text in German. Z. Hyg., 16(3):188-191, 1970. 12 refs.

The radium emanation of various coal and ash samples was determined. For this purpose, 5 g KOH was put into a nickel container and the water removed by melting over a burner; 5 g ash (with a particle size of less than 0.25 mm) was added to the cold melt. Through repeated heating, a clear melt was obtained which was converted into an alkaline iron hydroxide suspension to which 75 ml concentration HNO3 was added. The acid solution was diluted. The radium content of the various samples thus prepared ranged from 0.6 to 4.7 pCi/g flue ash. These concentrations agree with those stated in the literature. No remarkable difference was found between bituminous coal samples and brown coal samples or between samples with different geological formation. Differences were discernible between samples from geographically different sites. From the quantity of fly ash emitted by coal-fired power plants in the GDR, no inadmissibly high emission values were detected and calculated. The calculations were based on the most unfavorable long-term dispersion factor in the atmosphere as it generally occurs only at a source distance of 1 to 1.5 km. It was assured that the fly ash has the properties of aerosols over its entire grain size distribution and that it may become particularly toxic by readily pentrating into the lungs. The radium concentration caused by coal-fired power stations is at least 2 to 3 potencies below the admissible values for residential areas. Measurements of the ThX emission concentrations in random samples revealed that only 0.1% of the maximum allowable concentration (7 times 10 to the minus twelfth power Ci/cu m) was found in the vicinity of large power plants.

21318

Ebert, Konrad

THE FUTURE ROLE OF COAL IN THE NATIONAL AND INTERNATIONAL ECONOMY. (Die zukuenftige Rolle der Kohle in der nationalen und internationalen Wirtschaft). Text in German. Glueckauf (Essen), 106(7):337-346, April 2, 1970. 26 refs.

Statistical data indicate that the consumption of coal for power production will be the same in 1980 as it was in 1967. Mineral oil and natural gas will be used for covering the increasing energy demand. Coal consumption will be further on the increase in Eastern Europe while it will markedly go down in Western Europe. In Poland, soft coal mining rose from 9.3 million tons in 1960 to 24.5 million tons in 1968. In 1985, it will amount to 33.3 million tons. Of the 128.6 million tons of hard coal mined in 1968, about 26 million tons were exported. Power plants are Polands major consumer of coal, followed by remote heating plants. The same is true for the Soviet Union. In 1967, 39.3%, of the power was produced with coal; 37.8% with mineral oil; and 17.2%, with natural gas. In Czechoslovakia, 84% of the power is produced with coal. This high percentage will go down to 75.8% in 1970, and 61.2% in 1980 because mineral oil and natural gas from the Soviet Union will be imported for the balance of the total fuel consumption. In France, coal consumption will go down. In Italy, more fuel oil will be used than coal. In all other West European countries, a similar trend can be observed. This is mainly due to the high cost of coal as compared to the lower-priced mineral oil.

21351

Eisenbud, Merril and Henry G. Petrow

RADIOACTIVITY IN THE ATMOSPHERIC EFFLUENTS OF POWER PLANTS THAT USE FOSSIL FUELS. Science, 144(3616):288-289, April 17, 1964. 6 refs.

Analysis of the fly ash produced by combustion of pulverized Appalachian coal shows that a 1000-megawatt coal-burning power plant will discharge into the atmosphere from about 28 millicuries to nearly 1 curie per year of radium-226 and radium-228. An oil-burning plant of similar size will discharge about 0.5 millicurie of radium per year. Comparison of these data with data on the release of fission products from nuclear-powered generating stations shows that when the physical and biological properties of the various radionuclides are taken into consideration, the conventional fossil-fueled plants discharge relatively greater quantities of radioactive materials into the atmosphere than nuclear-powered plants of comparable size.

21383

Bowen, H. J. M.

ELEMENTARY CYCLES AND POLLUTION. Missouri Univ., Columbia, Proc. Missouri Univ. Second Annu. Conf. Trace Substances Environ. Health, Columbia, Mo., 1968, p. 171-179. 9 refs. (July 16-18.)

Global chemical contamination or pollution resulting from human activities is discussed. The two main air contaminants, resulting from oil and coal burning, are carbon dioxide and sulfur dioxide. The CO2 contamination is global, since tracer studies have shown that the half-life of a CO2 molecule is about 4 years. However, no measurable biological consequences have resulted from the amount of CO2 in the atmosphere. Sulfur dioxide pollution is mainly a local problem, since the half-life of an SO2 molecule is of the order of days. The natural rate of formation of SO2 has not been measured. Many workers have shown that SO2 from large cities has an adverse effect on vegetation. More information is needed about elements which may cycle through the atmosphere, notably selenium and mercury, neither of which have yet been detected in the air. The mathematics of complex cycles, such as the carbon cycle, need further clarification so that the effects of increasing CO2 contamination may be predicted. Soil and water pollution are also discussed.

21916

Cember, Herman, Richard W. Smith, and Mary Jane Oestmann

AN ESTIMATE OF THE INHALATION HAZARD FROM NEUTRON-ACTIVATED CONCRETE DUST. Am. Ind. Hyg. Assoc. J., 31(3):327-330, May-June 1970. 12 refs.

An evaluation was made of the radiological health hazard arising from inhalation of radioactive concrete dust, from a barytes aggregate concrete used for nuclear reactor shielding. This study involved (1) generation of airborne concrete dust particulates; (2) thermal neutron irradiation of the dust samples; and (3) measurement of the induced radioactivity samples. Inhalation of airborne activated concrete dust for several hours, at concentrations that may be encountered in practice, may be hazardous by ICRP occupational safety criteria, unless appropriate action is taken to reduce exposure. For example, exposure, after 13 days of cooling, for 8 hours in a concentration of 9 1/4 mg/cu m would lead to a 13-week radiation absorbed dose of 3900 mrads, which is the maximum permissible concentration according to the ICRP criterion. On the other hand, waiting 31 days after reactor shutdown, the worker would have to be exposed to a concentration of 27 1/2 mg/cum m for 8 hours before exceeding the ICRP recommendation.

21999

Athanassiadis, Yanis C.

PRELIMINARY AIR POLLUTION SURVEY OF VANADIUM AND ITS COMPOUNDS. A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., NAPCA Contract PH 22-68-25, Pub. APTD 69-48, 91p., Oct. 1969. 104 refs. CFSTI: PB 188093

The effects, sources, abatement, and methods of analysis for pollution due to vanadium compounds are discussed, as the average levels noted ranged from below detection (0.003 micrograms/cu m) to 0.30 (1964), 0.39 (1966), and 0.90 (1967) micrograms/cu m. Major sources are the vanadium refining industries, alloy industries, and power plants and utilities using vanadium-rich residual oils. One report on abatement indicated that an economic gain resulted from extracting vanadium from steam generators using vanadium-rich fuel. The methods of quantitative analysis of vanadium in the atmosphere that are available, including colorimetric, atomic absorption spectroscopy, emission spectrography, and polarography, provide sensitivities in the 0.001 microgram/cu m range. Vanadium is toxic to humans and animals, especially in its pentavalent form. Human exposure through inhalation of relatively low concentrations (less than 1,000 micrograms/cu m) has resulted in inhibition of cholesterol synthesis, and chronic exposure to environmental air containing vanadium has been statistically related to mortality rates from heart diseases and certain cancers. Exposure to high concentrations results in physiologically observable effects of varying severity on the gastrointestinal and respiratory tracts. Vanadium in fuels was found to be corrosive to heating plants.

22144

Strat, Georges Le

ANALYSIS OF THE TRACE OF ORGANIC PRODUCTS IN FUEL COMBUSTION FUMES. (Analyse des traces de produits organiques dans les fumees de combustion de fuel). Text in French. Rev. Gen. Thermique (Paris), 8(91-92):665-681, July-Aug. 1969. 83 refs.

Since 1963, the problem of qualitative and quantitative analysis of combustion gases has been studied in one of the two 24-burner oil-fired 770-ton/hr-capacity steam generators of the municipal heating plant at Saint-Ouen (Paris, France) for unburned gaseous organic compounds by means of a recording chromatograph (Perkin Elmer, Model F6) equipped with a flame-ionization detector, a digital integrator with printout device and a thermostatically controlled sample heating chamber as well as a mass spectrometer (C.S.F., Type SM100). Every phase of this work is described and discussed in detail, especially the problem of obtaining representative samples of the combustion gas. The finally adopted procedure, yielding reproducible quantitative results, involves the use of a suspension of finely-powdered vegetable charcoal R. P. in distilled water (1 gram in 100 ml) placed in a bubbling bottle cooled by melting ice, through which between 200 and 1000 cu dm of the combustion gas were passed to be partially adsorbed by the charcoal. To separate the adsorbent, the suspension is filtered or, preferably, centrifuged. The humid charcoal is placed, at ambient pressure, into a dessicator containing calcium chloride for 24 hr. For desorption of the organic constituents of the combustion gas, an aliquot fraction of the resulting pulverulent charcoal was placed into a pyrex tube between two pieces of quartz wool. This tube was attached to the inlet of a stainless-steel double-tubing immersed in liquid nitrogen and both were evacuated. After that the pyrex tube was heated very slowly to about 450 C. Finally the double-u tubing was closed and placed into the sample heating chamber of the chromatograph and heated to between 120 and 150 C for analysis; 2g of charcoal are required to analyze at one time the organic constituents present in 0.5 cu dm of combustion gases. A list of 54 different organic compounds identified in combustion gas samples obtained by the above procedure is given. Quantitative determinations of 14 organic compounds cited for illustration yielded concentrations ranging from 2 times 10 to the -5th power to 1.5 times 10 to the -2nd power grams per one kilogram of fuel oil burned.

22159

Harpporte, Dean R. De

COOLING TOWER SITE CONSIDERATION. Power Eng., 74(8):49-51, Aug. 1970.

Site selection for a new power plant now requires expert evaluation by a hydrometeorologist of the potential effects of the plant on the environment. No matter what method of cooling heated water is employed, the majority of heat from both nuclear and fossil-fueled plants is transferred to the atmosphere in the latent form through evaporation. When the heated water is cooled by exposure to a large amount of air in a cooling tower, resulting intense evaporation produces a dense cone-shape fog plume from a few feet to several thousand feet in length. Evaporation over a cooling pond is less intense, but is spread over a much larger area. Polluting agents in the plume and fog are heat and moisture. In selecting a plant site, the hydrometeorologist will first evaluate available meteorological data, and perhaps conduct a field study to determine the effects of topography, inversions, and wind patterns on the path and diffuison of potential cooling tower plumes or pond-induced fog. After the tentative selection of a site, supervises a fully instrumented, on-site study lasting at least one year. Wind, temperature, and humidity data are measured and continuously recorded at several levels of a high tower; if necessary, additional measurements of temperature and wind at higher levels are obtained through balloon and tracer studied. Whether the field studies are limited or detailed, predictive equations are applied to the field data to obtain the extent and frequency of the cooling tower plume or fog from the cooling pond.

22387

Demeter, J. J. and D. Bienstock

SULFUR RETENTION IN ANTHRACITE ASH. Bureau of Mines, Washington, D. C., Rept. of Investigation 7160, 12p., July 1968. 5 refs.

Anthracite from the four producing regions in Pennsylvania was both ashed in the laboratory and burned on a chain-grate stoker to determine the sulfur-retention properties of its ash. The retention of sulfur in laboratory-prepared anthracite ash is related to ashing temperature and to the amounts of sulfur and calcium present in the coal. At the usual laboratory ashing temperature of 750 C, sulfur retention ranges from 0.8 to 13.2% of the total coal sulfur. Sulfur retention in the ash is negligible, 0 to 0.3%, at 1200 C, which is the thermal decomposition temperature of calcium sulfate; thus calcium sulfate does not form and cannot serve as a sulfur-retaining agent. In several tests the anthracite was mixed with 6 or 10% dolomite prior to firing in the chain-grate stoker. The dolomite did not improve sulfur retention due to the high temperature in the fuel bed. Sulfur retention is, however, related to the unburned carbon in the ash. The relationship of the percentage of original coal sulfur retained in the ash (Y) to the percentage of the original carbon in the coal remaining in the ash (X) is expressed by Y equals minus 0.579 plus 0.914X. The percentage of sulfur retained is almost directly proportionate to the percentage of original coal carbon in the ash. (Author abstract modified)

22418

Hasz, Istvan

INFLUENCE OF THE STRUCTURE OF ENERGY CARRIER'S CONSUMPTION ON AIR POLLUTION. (Az energiahordozo struktura valtozasanak hatasa a levegoszennyezettsegre). Text in Hungarian. Energia Atomtech. (Budapest), 23(5):203-207, 1970.

In addition to meteorological and geographical conditions and the conditions imposed by urban planning, the greatest influence on air pollution comes from the quantity and quality of the fuels consumed in a given area. From an air pollution point of view, natural gas is the most desirable fuel; city gas is next, followed by sulfurless oils; other kinds of oils are next, followed by coke. The least desirable fuel is coal. The above ranking is based on the quantity of pollutants liberated from the different fuels while generating 1 times 10 to the 6th power Kcal useable heat. A dramatic change took place on a worldwide scale between 1950 and 1966, in the relative contribution to energy supply, of petroleum and coal: hydrocarbons increased from 34% to 54% and coal decreased from 59% to 39%. There are several technological-economical reasons for the increase in the use of hydrocarbon fuels, but air pollution considerations became lately quite powerful. As a consequence, Western European countries were forced to import a growing percentage of their energy carriers. The Hungarian coal reserves are small (good for 80-100 years) and expensive to use, but inadequate knowledge about the domestic oil reserves misdirected the Hungarian power industry towards the use of coal in the 1950's. This caused a significant increase in urban air pollution. Petroleum discoveries and better international cooperation during the second and third 5 year plan shifted the balance and new customers of energy rely exclusively on gas and oil. By 1980, coal will decrease from 72% in '60 to 26-29%; hydrocarbons will increase from 21% to 62%. Some imported electricity from the Soviet Union will be even used for heating in crowded cities. By 1970, the private (heating) use of coal will be largely eliminated by district-heating and conversion to oil and LPG (liquid petroleum gas). The substituted coal amounts to 10 times 10 to the 6th power t/year. Therefore, sulfur emission in Budapest will decrease by 57% from 1965 to 1980 and ash production by 81%.

22649

MHD: THE POWER GENERATION PROGRAM FOR ENVIRONMENTAL CONTROL. Natl Eng., 74(8):8-10, Aug. 1970.

A group of New England utilities have undertaken the design phase of a 50,000 kilowatt magnetohydrodynamic power generation which promises enormous advantages of air and water pollution control and which, eventually, is expected to eliminate the need for the steam turbine cycle. In a MHD generator an electrically conducting hot gas replaces the copper conductors of present-day power plants; thus, temperatures of 5000 F are typical of MHD operations compared to peak working temperatures to around 1000 F in present systems. Because of their higher efficiencies, the total amount of waste heat rejected by developed base-load MHD power plants will be less than half that rejected by conventional power plants of comparable capacity, and less than one-third that rejected by present-day nuclear power plants. MHD power plants can also be designed to operate without cooling water, and thus can eliminate thermal pollution of water. A reduction in electricity costs of up to more than 1 mill per kilowatt hr can be expected. Emissions of particulate matter, sulfur oxides, and nitrogen oxides are presented tabularly for conventional steam and MHD power production. A breakdown of production costs is also presented.

22800

National Academy of Sciences National Research Council, Washington, D. C., Committee on Air Quality Management

ABATEMENT OF SULFUR OXIDE EMISSIONS FROM STATIONARY COMBUSTION SOURCES. NAPCA Contract CPA 22-69-31, COPAC-2, 75p., 1970. 27 refs. CFSTI: PB 192887

In surveying the sulfur oxide problem and U. S. energy requirements, it is estimated that the requirement for electricity will more than triple in the next 20 years and that the use of coal will triple by the year 2000. These projections are related to longterm environmental considerations, energy research, factors of fuel utilization, and time phases of technical developments. Support of technology development by the coal industry, equipment manufacturers, utilities, and the federal government is surveyed, and the present status of research and technology is reviewed, including brief discussions of numerous specific processes. It is concluded that commercially proven technology for control of sulfur oxides from combustion processes does not exist and that a high level of government support is needed in addition to industry commitments to develop the necessary control measures. Certain control approaches are suggested for support, and a 5-year plan for future work is presented in which complete development of the limestone process is given high priority. Elemental sulfur is considered a more desirable by-product than sulfuric acid or sulfur dioxide, and the technology and costs of this conversion need thorough study.

22867

Davis (W. E.) and Associates, Leawood, Kans.

NATIONAL INVENTORY OF SOURCES AND EMISSIONS. CADMIUM, NICKEL AND ASBESTOS. 1968. SECTION II. NICKEL. NAPCA Contract CPA 22-69-131, NAPCA-APTD-69, 37p., Feb. 1970. 10 refs. CFSTI: PB 192251

The flow of nickel in the U. S. is traced and charted for 1968 in mining and processing, imports and exports, nickel stocks, and reprocessing (stainless steel, alloy steel, nickel alloys, electroplating, copper base alloys, catalysts, coinage, and batteries). Consumption was 159,306 tons and domestic production 29,215 tons from primary and secondary sources, with most imports from Canada. Nickel emissions are given by source and by states, and emissions factors and brief process descriptions are given for mining and metallurgical processing, reprocessing, and consumptive uses (oil, gasoline, and coal). Based on preliminary information, the particle size of nickel oxide emissions is assumed to be 0.1 to 1 micron. Emissions to the atmosphere during the year were 6475 short tons. About 83% of the emissions were due to the burning of heavy fuel oil and coal. Estimates of emissions for mining, metallurgical processing, and reprocessing operations are based on data obtained by personal contact with processing and reprocessing companies, and are considered to be reasonably accurate. Further effort is recommended to confirm the accuracy of the emissions from the burning of residual fuel oil and coal.

22875

Spencer, John D.

REVIEW OF BUREAU OF MINES COAL PROGRAM, 1967. Bureau of Mines Information Circ., no. 8385, 99p., June 1968. 72 refs.

Details of environmental studies featured in research and technological work on coal, and other research relating to the mining and utilization of coal are presented. Fly ash is evaluated for use in land reclamation and agriculture. Investigations of desulfurization methods include lime additives, centrifugation, wet tabling, and others. Programs to locate low-sulfur coal have been initiated. Sulfur dioxide recovery from stack gases is accomplished by absorption by alkalized aluminum, chromatographic sorption, manganese oxide absorption, limestone addition, catalytic oxidation, and the Reinluft process. The effectiveness of various methods for decomposing nitric oxide are tested. Costs for cleaning stack gases are estimated. Chlorine removal from gases and stack sampling methods are mentioned. The use of coal as a purification method for sewage is investigated. Studies to determine particle size ranges in mining operations are discussed. Occupational health as it relates to mining is studied. The relationship between coal dust and pneumoconiosis is studied, as well as methane-coal dust explosions. Gas chromatographic methods and ventilating systems used in mines are described. Coal processing and storing methods are discussed. Combustion research on coal as a fuel for power generation is reviewed, and catalysts for hydrogen-oxygen fuel cells are tested. Coke production represents a large market for coal. Gasification research and hydrogenation methods are disclosed. New uses for coal include the production of hydrogen cyanide, carbon black, lignite, and synthetic food for microbes. Composition and properties of coal and coal products are analyzed, and arsenic and fluorine content of coal are determined analytically.

23044

Ireland, F. E.

POLLUTION BY OXIDES OF SULPHUR. Chem. Engr. (London), 46(7): CE261-CE262, Sept. 1968.

Sulfur oxides arise from the combustion of sulfur-containing fuels such as coal, coke, and fuel oil; from sulfuric acid plants and miscellaneous uses of sulfur dioxide; and from the combustion of sulfur compounds in waste gases from manufacturing processes. Many investigations have been carried out on the removal of sulfur from fuel and on the removal of sulfur oxides from waste gases, but no generally practical methods have been developed. Thus, recourse is made to dispersion from suitably tall chimneys to reduce ground-level concentrations to acceptable limits. By controlling burner conditions to limit excess air in the gases, large users of fuel oil and electric power plants can reduce sulfur trioxide in waste gases from 40-50 ppm to about 5-10 ppm. In most countries, sulfuric acid is produced by contact processes that give a final acid emission to not more than two percent of the sulfur burned. Provided contact plants are equipped with adequate facilities for preheating, there should be no adverse local conditions produced by emissions. However, there is scope for research into acid mist formation and methods for its prevention at the source. Emissions from some chemical processes are often more concentrated than those from the combustion of fuel. It is common practice to remove the sulfur dioxide in these emissions by scrubbing with alkali solutions.

23170

Castleman, A. W., Jr.

A SUMMARY OF RECENT PROGRESS IN AEROSOL RESEARCH AT BROOKHAVEN NATIONAL LABORATORY. Preprint, Brookhaven National Lab., Upton, N. Y., 15p., 1969. 5 refs. (Presented at the Specialist Meeting on the Behavior of Nuclear Aerosols in closed Systems, Kernforschungszentrum Karlsruhe, Germany, Nov. 11-12, 1969.) CFSTI: BNL 14271

Progress being made on a program aimed at developing a fundamental understanding of the chemical reactions, mechanisms of release, and transport behavior of the fission products and radioactive aerosols emanating from nuclear materials under conditions likely to be encountered in the event of a fast-breeder reactor accident is described. Experimental work is designed to provide information on the nature of aerosols composed of plutonium, uranium, and sodium compounds. A theoretical program designed to provide a basic understanding of aerosol behavior in closed systems is described. Computer codes being developed for use in predicting the time dependence of the mass concentration, number concentration and particle size distribution are described. The codes are used in data correlation and evaluation as well as for making scale-up calculations to realistic power-reactor accident conditions.

23239

Chow, T. J. and J. L. Earl

LEAD AND URANIUM IN PENNSYLVANIA ANTHRACITE. Chem. Geol., vol. 6: 43-49, 1970. 8 refs.

Lead concentration, its isotopic composition, and the uranium content of Pennsylvania anthracites was determined. Mass spectrometic analyses were performed on samples which had been pulverized, weighed, and ashed at 425 C to constant weight. Square root of mass ratio corrections are incorporated in the data to compensate for velocity discrimination in the electron multiplier. Lead and uranium concentrations were determined by the isotope dilution method which is accurate to 0.01 micrograms. The ash content of the four washed Pennsylvania anthracites ranged from 9.5-12.8%, contrasted with the one Rhode Island unwashed meta-anthracite with 58% ash. The uranium concentration of three Pennsylvania anthracite samples was 1.55, 2.10 and 2.65 ppm, respectively. For the Eastern Middle, Western Middle, and Southern Field anthracites, the average lead concentration was 11.4 ppm, with the Northern Field sample having a lead concentration of 33.8 ppm, three times higher than the others. This disparity is also reflected in the isotopic composition, with the Northern Field anthracite lead being less radiogenic than the other three leads. From the isotopic analysis, it is interpreted that common lead was incorporated into the ancient, bedded plant material in Carboniferous times prior to coalification, while the uranium was introduced into the anthracite after coalification.

23359

Bienstock, D., R. J. Demski, and R. C. Kurtzrock

HIGH-TEMPERATURE COMBUSTION OF COAL SEEDED WITH POTASSIUM CARBONATE IN THE MHD GENERATION OF ELECTRIC POWER. Bureau of Mines, Washington, D. C., Rept. of Investigations 7361, 33p., March 1970. 19 refs. CFSTI: PB 190969

Open-cycle magnetohydrodynamic (MHD) elecprical power generation may play an important role in meeting the demand for electrical energy because of its high thermal efficiency and its ability to reduce materially both air and thermal pollution. In this technique, electricity is generated by the movement of ionized, high-velocity gases through a magnetic field. For central-power station generation, these gases would be produced by the high-temperature combustion of fossil fuels to which an easily ionizable material is added. In the experiments described, pulverized coal was mixed with potassium carbonate in concentrations up to 1.23 g-moles/kg coal. Combustion air was enriched with oxygen; coal, seed, and primary air was passed to cyclone burners. Hot combustion gases from the burner were then directed through a brick-lined furnace to a corrosion test tower, where samples of boiler-tube construction materials were maintained at wall temperatures of 800-1500 F and exposed to combustion effluent of 1800-2500 F. After cooling, the gases were passed to a cyclone dust collector. Practically complete removal of sulfur dioxide was achieved with the seed addition. Nitric oxide formation followed theoretical expectations at combustion temperatures; some decomposition of NO occurred during gas cooling. Nitrates in the fly ash were less than 1.7% of total fixed nitrogen. With aqueous extraction of the fly ash, a maximum recovery of 75% of the potassium was obtained. Haynes 25 boiler tubes showed no corrosion at wall temperatures of 1500 F in 2500 F seeded flue gas. The stainless steels 310, 316, and 446 were resistant at a metal temperature of 1100 F in gas at 2100 F, but carbon steel and Croloy 5 were attacked at 800 F wall temperature and 1800 F flue gas temperature.

23379

Dicks, J. B.

MECHANICAL ENGINEERING PROBLEMS IN ENERGETICS/MHD. Preprint, American Society of Mechanical Engineers, New York, 8p., 1969. 24 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, Los Angeles, Calif., Nov. 16-20, 1969.)

Magnetohydrodynamics (MHD) power generation is compared with coal- fired and nuclear plants in terms of power production, economics, and environmental considerations. Nuclear plants are superior to either conventional steam or MHD steam plants in terms of air pollution, but only at a great increase in thermal pollution. MHD plants produce less effluent per kwh than conventional plants due to their higher thermal efficiency, and because they incorporate very efficient, economical scrubbing units. Such units remove nitrogen compounds, sulfur dioxide, and almost all particulate matter. The problem of thermal pollution as caused by power generating stations is considered. Technical problems to be solved for the application of MHD plants are discussed.

23619

Anthrop, Donald F.

ENVIRONMENTAL SIDE EFFECTS OF ENERGY PRODUCTION. Bull. At. Sci., 26(8):39-41, Oct. 1970.

Construction of power plants with capacities of a 2300 MWe magnitude has serious implications for the ecology of the freshwater or marine systems in which the waste heat is disposed. Fossil fuel steam generating plants convert only 30-35% of the total thermal energy into electricity, while the remaining 65-70% must be dissipated, usually in a body of water. Nuclear plants are considerably less efficient and are unlikely to match the efficiency of fossil fuel plants within the next 20 years. Although the Navajo plant will use cooling towers, this technique will result in the evaporation of about 30,000 acre-feet of water annually in a region that already suffers a chronic water shortage. Electrical energy production in the U. S. increased from 180 billio kilowatt hours in 1940 to 1433 billion kwh in 1968. Looking then to the year 2000, the waste heat that would result from the production of 11.0 trillion kwh of electrical energy would be sufficient to raise the temperature of the total annual freshwater runoff from the conterminous U. S. by 24 F. Nuclear power generation offers the possibility of providing very large quantities of energy without increasing the carbon dioxide content of the earth's atmosphere, but it is beset with many difficulties. Burner reactors consume uranium-235, and if energy consumption continues to increase as projected, low-cost uranium resources could be exhausted within half a century. Although breeder reactors would enormously increase the nuclear fuels available for energy production by converting nonfissionable uranium-238 to fissionable plutonium-239, or by converting nonfissionable thorium-232 to fissionable uranium-233, some 65 such facilities would be required and the magnitude of thermal pollution would even be greater. To a considerable extent, energy can be converted into other resources. Also, any program to control energy consumption must also have as its goal the termination of population growth.

23652

Hull, Andrew P.

SOME COMPARISONS OF THE ENVIRONMENTAL RISKS FROM NUCLEAR AND FOSSIL FUELED POWER PLANTS. Brookhaven National Lab., Upton, N. Y., Hea Physics Div., 17p., 1970. 16 refs. CFSTI: BNL-14412

A comparison is made of the relative risk of pollution from the operation of nuclear and fossil fueled electric power plants. Consideration is given to air and water pollution by effluents, heat, and radioactivity. The possible effects on human life and health are considered, both from the possible pollution and from catastrophic accident. With regard to routine effluents, nuclear plants produce far less air pollution than their fossil fueled counterparts. The concentrations of radioactivity in their liquid effluents are controllable at levels well below radiation protection standards, and pose no threat to the environment. Contemporary nuclear plants are somewhat less thermally efficient than modern fossil plants, but the immediate waste heat problem appears manageable without causing serious environmental problems in a large body of water. Nuclear plants now being designed and tested promise to be as efficient as fossil plants.

23726

Land, George W.

COAL AND CLEAN AIR. Preprint, Society of Automotive Engineers, Inc., New York, 7p., 1970. (Presented at the Society of Automotive Engineers, Inc., New York, (Presented at the Society of Automotive Engineers, Earthmoving Industry Conference, Peoria, Ill., April 14-15, 1970, Paper 700552.)

Data on fossil fuel energy (coal, petroleum, natural gas) consumed in the U. S. since 1920 are presented to show that the increase in air pollution in recent years is not from coal, which has remained relatively constant on the average in quantities used. Evidence is also presented showing that less than 20% of the pollutants emitted into the air in a typical year arises from generation of electricit and space heating, the principal uses for coal. The combustion of coal produces solid and gaseous pollutants; almost complete control of particulates is technically and economically feasible, while control of gases, mainly oxides of sulfur and nitrogen, is much less advanced. Thus, low-sulfur fuels must be used; however, because of the shortage of low-sulfur coal in some areas (mainly the Midwest), gas or low sulfur oils are substituted. Increases in gaseous pollutants in the last 50 years are attributed to increased use of natural gas and petroleum, and it is concluded tha the nitrogen oxides and hydrocarbons together deserve much more control effort and research funds than they have received in comparison to sulfur dioxide, especially in view of their role in smog formation.

23753

Maxwell, Charles T.

U. S. ENERGY SOURCES IN THE EARLY SEVENTIES. Lawrence (Cyrus J.) and Sons, New York, Research Dept., 9p., July 23, 1970.

A new projection of U. S. energy production for the first five year of the 1970's, which assumes that energy will equal Gross National Product increases of 4.5% annually, foresees a restructuring of energy sources, which, unlike earlier predictions, includes a cutback in coal and gas and an advance of oil into the gap. The slower pace of natural gas production is attributed in part to lack of exploration and development of reserves due to federal regulation, while coal has financial, labor, transportation, and pollution problems which could restrict the industry to gains below the potential demand for the fuel. Despite its very rapid growth, nuclear energy is not expected to make an impression on the power 'shortfall' until the late seventies. Thus oil remains the only fuel source capable of being efficiently expanded in the near term to make up the gap; an overall oil growth of over 5% per year is predicted. Heavy oils can be desulfurized to meet tight pollution standards prior to burning, generally at an economic price. Most of the demand growth will be in two product classes, distillates and residual fuel oil, the latter to replace short gas and coal supplies in the electric power generation market. The effects of these changes on the profits of the oil industry are considered. It is noted that most of the low-sulfur No. 6 fuel oil imported into the U. S. is from four Caribbean refineries, where major desulfurization facilties are located.

23884

Beine, Helmut

ON THE CONTENT OF 3,4-BENZOPYRENE IN THE EXHAUST FUMES OF DOMESTIC STOVES WITH SOLID FUEL. (Ueber den Gehalt an 3,4-Benzpyren in de Abgasen von Hausbrandoefen mit festen Brennstoffen). Text in German. Staub, Reinhaltung Luft, 30(8):334-336, Aug. 1970. 24 refs.

The content of 3,4-benzopyrene was determined for emissions from different types of domestic stoves in which various qualities of coal are burnt. The methods used were gas chromatography or thin-layer chromatography, and ultraviolet spectroscopy. The 3,4-benzopyrene emission is particularly high in the case of nut-size anthracite briquettes burnt in complete combustion stoves and bottom firing stoves, that is, it lies between 370 and 380 mg/kg of coal. These high 3,4-benzopyrene emissions can be reduced to 2,2 mg/kg of coal by the use of a universal continuous burner.

23954

Steinberg, M., J. R. Powell, M. Beller, and B. Manowitz

A POLLUTION-FREE HYBRID FOSSIL-NUCLEAR FUELED MHD POWER CYCLE. Brookhaven National Lab., Upton, N. Y., 48p., March 1968. 13 refs. NTIS: BNL-12319

A hybrid power plant is developed based on a hydrogen-oxygen combustion MHD cycle. Hydrogen is generated by reforming fossil fuel with nuclear generated steam, and oxygen is obtained from air in an air separation plant. Steam is injected into the combustion gases to control temperature and pressure through the duct. A preliminary parametric study of the cycle efficiency and MHD characteristics is made with steam and helium as diluent. Overall thermal efficiencies of 55% appear practical with nuclear energy contributing 38% and coal 62% to the power cycle. Preliminary design capital investment, production cost, and breakeven fuel cost estimates are presented. The hybrid system offers a number of technical and economic advantages. It allows the use of fossil fuel in a pollution-free plant; conventional water and gas-cooled nuclear reactors can be utilized in an MHD cycle; thermal pollution is significantly decreased; a clean MHD duct is provided. The preliminary evaluation indicates that the system allows fossil fuel to compete with nuclear energy in high fossil fuel cost areas and conversely, it allows nuclear energy to compete in low fossil fuel cost areas, thus expanding the market for both fuel sources. Further detailed investigation of the system is recommended. (Author abstract)

24005

Cave, G. A.

DUSTS AND SMOKES IN FLUE GASES. Brit. Coal. Util. Res. Assoc. Monthly Bull., 10(3):61-70, March 1946. 98 refs.

Dusts carried by flue gases are considered with respect to their composition, mode of formation, and chemical and physical properties. The materials from which flue dust is formed derive in part from unburned carbon and in part from inorganic mineral constituents of coal. They consist of inherent as well as adventitious ash, and their composition may include most of the elements in the periodic table. With regard to boiler corrosion and deposits, the constituents of most interest are those that influence the fusability of the ash and those that determine the proportion of ash escaping as volatile material. Dust-producing materials are released and formed by decomposition, reaction, volatilization, and mechanical pickup. Properties of flue dust determining its accumulation on heating surfaces are density, size, thermal motion, reactivity towards gaseous flue-gas constituents, and electrical characteristics. Concentrations of dust in boiler gases depend on local conditions of gas movement; thermal gradient; the particular relationship between particle size, velocity, and direction of the gas stream; and on factors connected with the release of dust from the fuel bed. Size and basicity of ash particles or aggregates in a coal-dust firing system diminishes from the combustion chamber toward the chimney; solids emitted by the chimney may consist of highly siliceous and refractory single particles. Smoke-density meters are quite efficient for measuring smokes and suspended particles in flue gases at stack levels, and a variety of devices are available for separating dusts from flue gases. In general, the most effective meteorological element in controlling the concentration of smoke is turbulence.

24039

Drinker, Philip

AIR POLLUTION PROBLEMS IN THE UNITED STATES. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 21-36. 11 refs. (Nov. 6-14.)

As in other countries, the demand for power in the U. S. is increasing steadily, at an estimated 3% annually. Bituminous coal is still the most used fuel, followed in order by oil and gas. Some of the coals used in the mid and far-west have a sulfur content as high as 5%; thus some very large power stations emit sulfur dioxide in amounts comparable to those from smelters roasting sulfide ores. There is a general rule in the U. S. requiring power stations that burn coal in powdered form to clean their stack effluents of grit and ash before discharge. It is also common practice to make an extensive meteorological survey before building a tall chimney, to insure an adequate height for dispersion of smoke plumes. Pollution from ore smelters, by fluorides, and from vehicle exhausts, with emphasis on smog effects is discussed. Attention has not been paid to date to nitrogen oxides in chimney gases; these concentrations increase with furnace temperatures, so that the better the plant is run the more oxides of nitorgen are given off. Although the technology for control of the more well known pollutants has made considerable progress, no practical method has yet been devised for control of nitrogen oxides.

24500

Mie Prefecture (Japan), Public Nuisance Control Bureau

REPORT ON THE SPECIAL INVESTIGATION OF AIR POLLUTION IN THE YOKKAICHI DISTRICT. (Yokkaichi chiku taiki osen tokubetsu chosa hokoku sho). Text in Japanese. 20p., March 1964.

The industrial complexes in Yokkaichi consists of two large-scale complexes and a heavy-oil combustion steam power plant; the total amount of fuel oil used per year occupies 99% of the total. The complexes were built during the period of economic growth, and little attention was paid to public nuisance control. Winds blow NW in winter and SE in summer. The main pollutants are sulfur oxides arising primarily from heavy-sulfur oil combustion. The concentration sometimes goes up to about 0.2 ppm (electroconductivity method). Soot and dust particles are also a problem, but they are decreasing over the years due to the decreasing use of solid fuels. There are, however, individual factories that produce much soot and dust. Other pollutants include obnoxious odors and noise. The control measures involve enforcing environmental standards (tabulated); taking appropriate steps such as treating sulfur oxides arising from sulfuric acid manufacturing plants; restructuring the urban structure of Yokkaichi; creating buffer zones between factories and nearby residential areas; establishing clean-air rooms in medical facilities to treat the emergency cases of respiratory diseases caused by air pollution; creating an air pollution monitoring network; and building meteorological stations.

24508

Chubu Electric Co. (Japan)

MIE STEAM POWER GENERATING STATION. (Mie karyoku hatsudensho). Text in Japanese. 7p., 1969 (?).

The pamphlet issued by Chubu Electric Power Co. describes the Mie Steam Power Generating Station in Yokkaichi. The station is capable of producing 341,000 Kw. It occupies 163,932 sq m, and can store 146,000 tons of coal. The four generators can operate in the steam temperature range of 510 to 538 C, and their thermal efficiency ranges from 33.4 to 37.6%. Diagrams describe the process of power generation, and the characteristic features of the stations are explained. The transition from hydro-electric to stea power generation from 1954 to 1968 fro Chubu Electric is shown.

24535

Chubu Electric Power Co. (Japan)

CONTROL OF PUBLIC NUISANCE FROM STEAM POWER STATIONS. (Karyoku hatsudensho no kogai taisaku). Text in Japanese. 28p., Nov. 1965.

The pamphlet issued by Chubu Electric Power Co. includes maps indicating the locations of the company's various power generating stations and the tabulated description of each plant, together with pollution control capabilities. A detailed diagram of the general public nuisance control law hierarchy on the national, regional, and local government level and its relationship to the Chubu Electric Power Co. is presented. Meticulous descriptions of how pollution originates in petroleum, petroleum-coal, and coal steam power plants and how they can be controlled are introduced, as well as how ashes and soot can be removed, how water pollution from power stations can be controlled, and how obnoxious noise from the stations can be controlled.

24732

Spaite, Paul W. and Robert P. Hangebrauck

POLLUTION FROM COMBUSTION OF FOSSIL FUELS. In: Air Pollution-1970 Part I. 91st Congress (Senate), Second Session on S.3229, S.3466, S.3546, p. 172-181, 1970. 3 refs. (Hearings before the Subcommittee on Air and Water Pollution of the Committee on Public Works, March 16, 17, 18, 1970.)

Currently, emissions of fly ash, sulfur oxides, and nitrogen oxides by fossil fuel burning sources come to about 45 million tons per year in the United States, and consumption of fossil fuels is doubling every 25 years. These emissions originate in power plants industrial boilers, and smaller installations used for commercial and residential heating. Power production, which accounts for 70% of the present total sulfur oxide emissions from combustion and over 90% of the total anticipated in 30 years, is by far the most important source judged on the basis of total contribution from all combustion sources. Even when consideration of the nature of the control problem is limited to coal burning power plants, the problem of nonuniformity in the processes which must be controlled still is apparent. Factors such as plant size, plant age, and a host of considerations associated with location make each power plant a unique control problem. Oxides of nitrogen range from an estimated 9 million tons at present to about 25 million tons by the year 2000. Presently available equipment for fly-ash control does not efficiently collect particles less than approximately 1.0 micron in diameter. Fine particulates tend to remain in suspension in the upper atmosphere, where continued build-up of such materials could produce unacceptable worldwide climate changes. From the control point of view, combustion source can be divided into three classes with distinctly different characteristics as far as the nature of the control problem is concerned: boilers under 500 million Btu/hr capacity, existing boilers larger than 70 mw, and large new boilers that will be built in the future and for the most part will be 500-1000 mw in size.

24817

Hoshizawa, Kinji and Kazuo Koyata

FORMATION AND THEIR PREVENTION OF ACID SMUTS AT OIL FIRED BOILER. (Juyu nensho ni yoru asiddo sumatto no hassei to sono boshi taisaku). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 49(521):656-665, Sept. 20, 1970. 7 refs.

The capacity of thermal electrical generation in Japan recently reached 27,600,000 kw, or 10 times the 1951 figure. This was accomplished with 26 million tons of coal and 19 million kl of heavy oil. The capacity of a single generator has increased also to about 350-600 mw. The use of heavy oil is expected to reach 35 million kl in 1971, and 500 million kl in 1975. The sulfur content of the fuel is about 2%, requiring stacks as high as 200 m to disperse the gas. Some power stations have changed to liquefied natural gas. If this contains sulfur, however, acid smuts are formed by the combination of dust and sulfur trioxide gas Field tests indicate that the smuts were mainly formed in the stack and fell within 400 m from the stack in conditions of light wind. Full load conditions and load up periods were critical in terms of smut emissions, which increased with increased excess air. Thre methods of prevention tried against acid smut emissions were to maintain minimum excess oxygen under 1.0% in order to decrease the acid dewpoint below the flue gas temperature; to neutralize SO3 by means of ammonia injection of over 0.04% by weight of fuel oils; and elimination of dust, which does reduce the smut problem. Although measures have been taken to prevent air pollution, little has been learned regarding the formation mechanism of acid smuts.

24915

Ter Linden, A. J.

AIR POLLUTION IN HOLLAND. In: Problems and Control of Air Pollution. F. S. Mallette (ed.), New York, Reinhold, 1955, Chapt. 22, p. 236-244.

Recent investigations made near a large power station in Holland, where people were complaining bitterly about desposited dust, showed that 75-80% of the dust collected in the exposed region consisted of particles larger than 50 microns, although the dust leaving the stacks contained only 10-15% particles with diameters greater than 50 microns. Thus the weight of the deposited matter in grains per sq ft per day, not the dust content of the gases inside the stack, is the measure of the nuisance in the exposed area. The solution of the dust problem in the case of coarse particles is to be found in the installation of selective dust separators with a collection efficiency of about 100% for particles larger than 40 microns.

24916

Rees, R. L.

REMOVAL OF SULFUR DIOXIDE FROM POWER-PLANT STACK GASES. In: Problems and Control of Air Pollution. F. S. Mallette (ed.), New York, Reinhold, 1955, Chapt. 14, p. 143-154. 16 refs.

At a London power station, more than 95% of the sulfur dioxide is removed from flue gases derived from 3.8% sulfur oil by washing the gases with water supplied by the river Thames. The gas is washed on grid scrubbers, with a small amount of chalk added to the water to maintain its alkalinity. Crude manganese sulfate is added to the effluent to activate the oxidation of sulfite in the aeration tank. The effluent also passes through a settler to remov excess solids before being mixed with 12 times its bulk of water. The product of the treatment, calcium sulfate, is returned to the river in solution. The defects of the process are the high cost of maintenance, the extent to which it cools the gas, and the severe limitations on the sites at which it can be used. Alternative processes are the costly cyclic lime process and the ammonia liquor process, which is restricted in its application by the supply of ammonia liquor.

24951

Luce, Charles F.

UTILITY RESPONSIBILITY FOR PROTECTION OF THE ENVIRONMENT. Arizona Law Rev., 10(1):68-73, Summer 1968. (Presented at the Federal Bar Association Bureau of National Affairs Briefing Conference, Washington, D. C., March 15, 1968.)

Not only must the public utility supply today's needs of its customers for electric energy, it must forecast what those needs will be decades into the future, and make investment commitments of large sums of capital based upon the forecasts. Today a new and even larger concept of utility responsibility is emerging, and it extends not only to concern for the natural environment, but also for the social and economic environment of the communities which are served. The new concept of public utility responsibility is not easily applied. For example, should a utility spend $140 million to put 25 miles of transmission lines underground when they can be placed overhead for 12 million? If so, who should pay the added costs? In 1967 Con Edison's plants contributed less than half of the sulfur dioxide in New York City's air and about 15% of the particulates, but by 1980 it expects to generate 75% of its electricity in nuclear plants, thus eliminating the smokestacks. Approximately $150 million has been spent on air pollution control devices, including precipitators that remove 99% of the ash from the stacks of the coal burning plants. To make the city less noisy, Con Edison is procuring new and quieter equipment to break the city pavement, and installing transformers which produce a minimum hum. Thirty percent of the new employees last year were Negroes and Puerto Ricans, while a job training program was offered for high school dropouts.

24955

Steinberg, M., J. Powell, and B. Manowitz

THE WESTERN COAL DEPOSITS: A NATIONAL SOURCE OF POWER. Brookhaven National Lab., Upton, N. Y., Dept. of Applied Science, 28p., Nov. 1969. 40 refs. NTIS: BNL-50187

To unlock the reserves of the sub-bituminous and lignite coal field of Montana, North Dakota, Wyoming, and Alaska, it is proposed that large power plants of -5000 Mw(e) capacity be located in coal field served by open-strip mining of the relatively shallow thick layers of coal. An efficient power cycle is conceived that uses gasification for removal and possible recovery of U-bearing ash and production of gas which can be burned with air in a large magnetohydrodynamics generator for the production of high voltage dc. The dc can then be directly transmitted in a high-capacity, long-distance cryogenic line. Of the alternatives of shipping coal gas, or electrical power to the large power-consuming centers of th west and east, the latter is the most desirable and inherently the most economical. It is estimated that 100,000 MW(e) could be piped to the west coast and could interconnect with hydropower from the north in one big western loop; another 100,000 MW(e) could be piped to the east and south, interconnecting with the Illinois, West Virginia, and Pennsylvania coal fields. The entire country would thus be looped with electrical transmission carriers connecting with main energy sources from which local power grids can draw in preparation for an all-electric economy. The nuclear plants can either be located at the same sites as the coal plants or spotted along main feeder grids around the country. Investment costs for 10 plants giving a total of 50,000 MW(e) would be 4.35 billion dollars; costs of transmission lines for 1000 miles would be 2.46 billion dollars. It is noted that locating the power cycle at the mine site and the method of transmission, would remove the air pollution problem from the cities and allow cleaner and quieter use of electrical power at the consuming center. Electron transmission, unlike gas transmission, does not require th construction of an electrical power plant at the energy consuming center.

24978

Lyons, D. E.

LIME AND THE CONTROL OF POLLUTION IN THE POWER INDUSTRY. Pit Quarry, 63(5):87-89, Nov. 1970.

To meet proposed Federal and State restrictions on the emission of sulfur oxides, the power industry will probably use lime, limestone, or dolomite as an additive when burning fossil fuels. Economic operation of other processes depends on the sale of byproduct sulfur; due to their high capital cost and the questionable sulfur market, these methods are not practical for the industry. Items of equipment that must be installed in a limestone and/or dolomite additive system include an additive silo, wet scrubber, feeder, and pulverizer. The limestone is ground in the pulverizer to the consistency of powder and blown into the furnace above the fuel and air streams. One system is designed to remove 90% of all particulate matter entering the scrubber and to reduce the sulfur dioxide level in the flue gas about 85%. Based on the use of three percent sulfur fuel, limestone or dolomite requirements are estimated to be 108 million tons a year by 1980.

25062

Kobayashi, Osamu

AIR POLLUTION COUNTERMEASURES FOR THERMAL GENERATING STATIONS. (Karyoku hatsudensho no kogai taisaku ni tsuite). Text in Japanese. Kagaku Kogyo (Tokyo), 21(12):1624-1627, Dec. 1, 1970.

The demand for power within the area served by Tokyo Electric Power Company increases by 13% annually. In 1970, the peak demand reached 15,690,000 kw, exceeding last year's maximum by over 2 million kw. There is more demand for the type that permits no power failure, such as demands by information centers, medical and transportation facilities, and underground streets. For the moment, electric power generation is still thermal generation, with heavy and crude oils as fuels. Five new stations, totaling 7 million kw, are being constructed after complete agreement has been reached with local autonomous bodies concerning anti-pollution measures. The company's fuel policy includes obtaining heavy oil with less sulfur, burning crude oil rather than heavy oil, and the use of liquefied natural gas. As to equipment, adoption of tall chimney stacks, high capacity dust collection equipment, and effluent treatment devices can be mentioned. Anti-pollution investment compared to the total investment on thermal generation reaches 15-16%. Boilers are equipped with automatic control devices and efforts are made to prevent acid smut emission. In accordance with local regulations when a 'critical' situation is declared, ultra-low-sulfur oil is used. The activated charcoal method is adopted in smoke reduction and desulfurization; basic research for this method has been ongoing since 1963. The principle behind this equipment is: eliminating soot through dust collectors, then leading the smoke through the towers filled with activated carbon, and discharging the cleaned smoke through the chimney stack. The activated charcoal which adsorbed sulfur dioxide is cleaned with water, from which sulfuric acid is later recovered.

25108

Badzioch, Stanley and Peter G. W. Hawksiey

KINETICS OF THERMAL DECOMPOSITION OF PULVERIZED COAL PARTICLES. Ind. Eng. Chem. Process Design Develop., 9(4):521-530, 1970. 12 refs.

An apparatus is described for measuring the extent of thermal decomposition of size-graded coal particles in the pulverized-fuel size range at temperatures up to 1000 C and times ranging from 30 to 110 msec. The particles are heated to the decomposition temperatures at high rates (25,000-50,000 C/sec) comparable with those occurring in pulverized-fuel firing. The yield of volatile products under these rapid heating conditions was 1.3 to 1.8 times higher than the change in volatile matter found from the difference between the proximate volatile matter of coal and that of char. Analysis of data obtained for 10 bituminous coals and one semianthracite yielded empirical equations suitable for calculating the progress of devolatilization of pulverized-fuel particles when their temperature history is known. (Author abstract)

25196

Shannon, Larry J., A. Eugene Vandegrift, Paul G. Gorman, Eugene E. Sallee, and M. Reichel

EMISSION AND EFFLUENT CHARACTERISTICS OF STATIONARY PARTICULATE POLLUTION SOURCES. Preprint, International Union of Air Pollution Prevention Associations, 36p., 1970. 2 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-22F.)

A particulate pollutant system study was undertaken to overcome deficiencies in our knowledge regarding the nature and magnitude of particulate pollutant emissions from stationary sources in the United States. The objective of the study was to identify, characterize, and quantify the particulate air pollution burden resulting from stationary sources. A quantitative ranking is presented of staionary sources, projections of their potential emission levels up to the year 2000, and information on the effluent characteristics (particulate and carrier gas) of the major particulate pollutant sources. A ranking of sources on the basis of total tonnage of emissions per year was developed. Total tonnage emitted by a given source or industry was determined from four quantities: an emission factor for the uncontrolled source; the total tonnage processed per year by the source; the efficiency of control equipment used; and the percentage of production capacity equipped with control devices. In some cases computation procedures based on outlet grain loadings or material balances were also employed. The major stationary sources of particulates are electric power generation plants, the crushed stone industry, agriculture and related operations, the iron and steel industry, and the cement industry. Forecasts of the level of particulate pollutants emitted from stationary sources up to the year 2000 were developed by taking into account: changes in production capacity; improvements in control devices; and legislative or regulatory action to enforce installation of control equipment. These forecasts indicate that particulate emissions can be reduced to about one-sixth of the current level by 1980 through the installation of currently available control devices on all sources. The projections also suggest that reduction of particulate matter will most likely occur by installation of control equipment on uncontrolled sources and by shifts to more efficient types of collection equipment rather than by any major improvements in the efficiency of a specific type of control device. A matrix of effluent properties for the major particulate sources is presented. Particulate characteristics discussed include particle size, solids loading, and chemical composition. Carrier-gas properties tabulated include flow rate and chemical composition. (Author abstract modified)

25213

Hidy, G. M. and J. R. Brock

AN ASSESSMENT OF THE GLOBAL SOURCES OF TROPOSPHERIC AEROSOLS. Preprint, International Union of Air POllution Prevention Associations, 41p., 1970. 30 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper ME-26A.)

Based on current knowledge of the sources and production mechanisms of tropospheric aerosols, an assessment is made of the relative contribution of material from natural and anthropogenic origins. The survey indicates that more than half of the aerosol presently in the lower atmosphere comes from 'secondary' processes such as chemical reactions in the gas phase. The principal known or suspected participants in such reactions are volatile hydrocarbons, nitrogen oxides, ammonia, and sulfur compounds such as hydrogen sulfide and sulfur dioxide. The man-made contribution at this time amounts to about 6% of the total production rate, which is set at approximately 10 to the seventh power tons/day. A projection of the expected production rate assuming middle 1960 control methods suggests that the anthropogenic portion will increase the total aerosol concentration in the troposphere by about 11% through the year 2000. This increase will reduce the visibility by a corresponding amount, and it may reduce the amount of solar radiation reaching the earth's surface about 2% in the middle latitudes. (Author abstract modified)

25256

Cisler, W. L.

THE MEANING OF ENERGY FOR MAN AND HIS ENVIRONMENT AND FOR ECONOMIC PROGRESS. (Die Bedeutung der Energie fuer den Menschen und seine Umwelt und fuer den wirtschaftlichen Fortschritt). Text in German. Brennstoff-Waerme-Kraft, 22(8):381-382, Aug. 1970. (Presented at the Deutsche Nationalen Komitee der WeltenergieKonferenz, Essen, West Germany, April 10.)

Fossil fuels stored in the earth by Natural processes over a period of about 600 million years are being used in steadily increasing quantities. Also coal has been mined for about 800 years, but half of the total amount was mined and used during the last 33 years, and about half of all the petroleum used by mankind was obtained during the past 14 years. It has been estimated by expert that if the present trend of consumption continues, the supplies of petroleum, natural gas, oil shale, and heavy oil sand will be used up in another 100 years, and the coal supply will be completely consumed in 200-300 years. In the field of nuclear power, the picture looks a little more hopeful. Whereas the contemporary types of reactors only have a 1-2% efficiency, new types being developed promise to make use of about 80% of the energy in uranium.

25259

WHAT DEMANDS ARE MADE ON THE ENERGY SUPPLY BY ENVIRONMENTAL DESIGN AND THE INCREASING REQUIREMENTS OF MAN? (Welche Anforderungen stellen Umweltgestaltung und steigende Bedwerfnisse des Menschen an die Energiedarbietung?). Text in German. Brennstoff Waerme-Kraft, 22(8):383-388, Aug. 1970. (Panel Discussion at the German National Committee of the World Power Conference, Annual Meeting, Essen, West Germany, 1970.)

Representatives of the various power industries (nuclear energy, soft coal, oil, anthracite, gas, and electricity) discuss the increasing demands made on the world power supply from a two-fold standpoint: environment and the human element. At the present time, fuel oil represents 52% of available power in West Germany, and is expected to reach 56% by 1980. In the powering of motor vehicles, the volatile fuels account for 90% of the fuel supply and diesel fuels about 60%. In the field of space heating, light fuel oils account for about 50% of the power sources used. The petroleum consumption for 1969 was 100,000,000 metric tons, and the estimated annual consumption for the early 1980's is 180 million tons. In 1969 the free-world consumption of aviation fuel was 100 million cubic meters, of which West Germany used only 1.8 million, or 30 liters per capita. The projected consumption for 1980 is 9 million cubic meters, taking into account the expected increase in European travel by then. Newly constructed power plants put into operation 1966-1971 have a capacity of 8500 MW. Coal is used as the fuel for about 25% of the electric plants in West Germany, and this figure is expected to remain constant for some time. The projected coal consumption in power plants for 1975 is 34-37 million tons. Nuclear power by 1980 is expected to be about 15,000-25,000 MW, at which time the demands for electric power will have doubled, so that this will still represent only 25% of the total picture. Electrical power plants represent 70% of the consumption of lignite, and new plants using lignite represent an output of 3000 MW. West German mines can only deliver an estimated 10,000 tons of uranium, whereas by 1980 a total of 53,000 tons would be needed for West German nuclear plants, necessitating extensive importation of the ore.

25418

Babcock, Lyndon Ross, Jr.

SOME AIR POLLUTION IMPLICATIONS OF ENERGY TRANSFORMATION AND USE. Washington Univ., Seattle, Dept. of Civil Engineering, Thesis (Ph.D.), 1970, 304p. 105 refs.

Descriptive air pollution and energy information are presented in an attempt to relate energy and urban form relationships to air pollution. Facets of this information were combined into a quantitative simulation called urbsim which was manipulated to show the effects of major variables on overall air quality and upon energy cost. The response curves suggested that, from an air quality standpoint, it is desirable to nucleate new cities rather than to allow existing cities to grow indefinitely. The validity of the simulation was assessed when urbsim was used to compare overall air pollution levels in two real cities. The urbsim ranking agreed well with a ranking derived from ambient air quality data measured in the same two cities. Despite its generality and approximate nature, urbsim seems to be a useful tool for comparing real cities. A means of combining ambient levels of six pollutants to enable assessment of overall air quality is presented. Urbsim was used to rank the severity of major emission categories in the USA. When toxicity and population distribution corrections were made, the relative importance of the automobile as an air pollution source was reduced. (Author summary modified)

25545

Mashek, V.

SOOT OBTAINED FROM SOLID FUELS. (Sazhi ot tverdykh topliv). Text in Russian. Gigiena i Sanit., no. 7:85-87, 1970. 11 refs.

Analysis of soot samples taken in the vicinity of the city of Ostrava, Czechoslovakia, and resulting from the combustion of coke, anthracite, lignite, lignite briquets, or wood are reported. About half of the material collected consisted of silicon dioxide, with 2-9% iron, 0.3-0.6% sulfur, and trace amounts of arsenic. Specific surface of the soot was low (2.5-16 sq m/g) while ash content range from 28 to 82%. Benzo(a)pyrene content was lowest in coke soot, (0.1-0.2 microg/g) considerably higher in soot from wood (11.5-20.1 microg/g), and anthracite (7.5-9.2 microg/g); the mode of burning was more important than the type of fuel burned.

25549

Kettner, H. and R. Langmann

OBJECTIONABLE SOOT EMISSIONS. (Zur Frage des Auftretens von Belaestigungen durch Russ). Text in German. Oeffentl. Gesundheitswesen (Stuttgart), 32(7):346-348, July 1970. 3 refs.

Soot emission sources include household furnaces, internal combustion engines, small industries, thermal power plants, coke ovens, airplanes, nonferrous metal smelting plants, railroads, incinerators, carbon black works, incinerators of agricultural residues, forest fires, fires from burning old tires, from old oil and from tar. Soot is not harmful when pure but soot from sulfur containing heavy oil (smut) contains considerable quantities of sulfuric acid. Soot is also a carrier of cancerogeni 3,4-benzpyrene in smogs and is a contributory factor in the formation of smog. Soot is objectionable as a deposit. An objective soot emission test filters a dust precipitate deposited in a month through a glass wool filter and measures the blackness of the stain by an optical electric reflectometer. The thus obtained soot pollution index is a dimensionless number which calculated for 1 day lies between 0.2 and 3. This method permits the setting of norms of maximally permissible soot emissions which has hitherto not been done.

25689

Gambs, Gerard C.

POWER PLANT ASH--A NEGLECTED ASSET. Mining Engineering, 19(1): 42-44, Jan. 1967.

When coal is burned in electric utility plants, ash is produced in one of several forms. These include fly ash, bottom ash, and bottom slag. At the present time, approximately 20 million tons of these ashes are produced and must be disposed of by the utilities at a cost of $.50 to $2 per ton. However, when used to replace a portion of the cement in a concrete mix, fly ash will produce the highest quality concrete. As much as $.01 to $.02 per million Btu could be taken from the fuel cost for each ton of ash sold which otherwise must be disposed of at a cost. Examples of the use of fly ash concrete are indicated. The relative compression strength of fly ash and regular concrete is presented, as well as the physical and chemical analyses of fly ashes used for construction projects. Fly ash consists principally of the oxides of iron, aluminum, and silica. These combine with the free lime liberated as the concrete ages and form additional cementing materials. The use of fly ash in concrete prevents free lime from being leached. Since the fly ash is substituted for cement on a pound for pound basis, fly-ash concrete can usually be sold for about $1 per cu yd less than regular concrete.

25690

Hirose, Rokuro

CRUDE OIL FUELS TWO 375-MW UNITS IN JAPAN. Elec. World, 168(26):25-26, 31, Dec. 25, 1967.

Crude oil fuels two 375-Mw units at Chita Thermal Power Station of Chubu Electric Power Company, Japan. Even when the cost of additional protective equipment was included, the cost of generating power from the crude oil was 10% below that of generation with residual oil. In the refining process, an estimated 80-90% of the sulfur, as well as other objectionable constituents, becomes concentrated in the residual oil. Thus, burning crude instead of residual oil reduces sulfur dioxide pollution of the air. To guard against fire and explosion when crude oil leaks, gas monitors provide operators with alarm and lamp indications. Patrolmen are also trained to inspect a number of additional items during crude-oil firing. Piping is welded to reduce the possibility of leakage, while other equipment is flanged and grounded to prevent static discharges. For protection against low-viscosity oil, the rotors are plated with a special nickel alloy for wear and corrosion-resistant qualities. Two propellor type agitators prevent accumulation of sludge in one storage tank, and a nozzle type agitator in the other. The crude oil flame is shorter than that of residual oil. Several other differences between the two fuels are mentioned.

25867

Friedlander, Gordon D.

POWER, POLLUTION, AND THE IMPERILED ENVIRONMENT. II. EAST, MIDWEST, AND WEST COAST: POLLUTION-CONTROL PLANS OF SOME MAJOR UTILITIES; ROLE OF GOVERNMENT IN ENVIRONMENTAL MATTERS; OTHER PROPOSED SYSTEMS FOR REDUCING STACK EMISSIONS. IEEE (Inst. Elec. Electron. Engrs.) Spectrum, 7(12):65-75, Dec. 1970. 3 refs.

A number of the largest utility companies are embarking on large- scale nuclear generating plant construction programs that may phase out up to 50% of their fossil-fuel stations by the end of the 70's. This move is being encouraged by electrical suppliers who, with the utilities and the AEC, are striving to convince the public that nuclear stations are completely safe and provide the best means for air-pollution abatement. Nevertheless, many fossil-fuel plants are still being planned and built, and more efficient methods of reducing stack gas emissions will have to be incorporated at these facilities if a general reduction in air-pollution levels is to be achieved while simultaneously meeting the accelerating demand for more energy. Government, too, has a role to play and a responsibility to fulfill in the public interest by enacting fair and practicable pollution-control legislation, and ensuring the enforcement of such statutes. (Author abstract modified)

25914

Watanabe, Hironobu

RADIATION SAFETY OF POWER REACTORS. PART I. ENVIRONMENTAL CONTAMINATION AND ITS EFFECTS TO THE PUBLIC. (Doryokuro no anzensei. Ichi. Kankyo osen to sono eikyo). Text in Japanese. Nippon Genshiryoku Gakkaishi (J. At. Energy Soc. Japan), 12(10):611-619, Oct. 30, 1970. 15 refs.

Radioactive material stored in nuclear power plants are mainly sintered pellets of condensed uranium oxide and those contained in the fuel rods. The emission of radioactive material into the environment may be caused by damage on the protective tubes for fuels. A table of the storage capacity for radioactive rare gases inside the reactor is given by types of nuclides, half-life, energy (MeV), emission rate, and maximum emission rate from exhaust pipes (mCi/sec). Other items discussed are the mechanism of environmental radioactive pollution, the mathematical evaluation of pollution, and environmental monitoring. A table of the concentration factor (CF) for edible sections of various marine life such as fish, shellfish, and seaweeds is presented by types of nuclides, the name of the organism, and CF. The effects of dosages of radioactivity on humans, the exposure quantity in the neighborhood of a power reactor, and exposure to natural radioactivity such as cosmic rays are discussed.

25975

Erdmann, Robert C.

POWER: CONTROL OF RADIOACTIVE EMISSIONS FROM NUCLEAR REACTORS. In: Project Clean Air. California Univ., Berkeley, Task Force No. 5, Section 8, 7p., Sept. 1, 1970. 7 refs.

Estimates of the level of radioactivity from natural sources range from 0.1 to 0.8 rem, depending on the area of the world in which an individual lives. Maximum permissible concentrations are derived or secondary standards, which are intended to preclude exposure of the public to the annual dose commitment. Example reactor emissions are presented tabularly. Basic and applied research needed includes a full scale emissions study, monitoring requirements, fuel reprocessing, reactor siting, atmospheric thermal problems, and reactor regulations.

26085

Reardon, W. A., J. A. Merrill, L. D. Jacobson, and W. L. Bathke

A REVIEW AND COMPARISON OF SELECTED UNITED STATES ENERGY FORECASTS. Battelle Northwest, Richland, Wash., Pacific Northwest Labs., 79p., Dec. 1969. 20 refs.

Energy projections of a number of forecasts are collected and compared, and the methodology used by the various forecasters assessed. According to the forecasts examined, energy consumption in the year 2000, including non-fuel uses, will be about 170,000 trillion British thermal units if real gross national product grows at four % per year. Although this figure appears reasonable, it does not reflect the emerging concern for protecting the environment. It is possible that future government policy in regard to environmental quality and conservation will lead to a lower level of total energy consumption than would otherwise occur. In addition, the figure quoted may not adequately reflect possible changes in efficiency of energy conversion and changes in the structure of consumption, especially the larger share going into electric power production. Oil (including natural gas liquids) is expected to remain the nation's largest energy source through 2000 and natural gas (dry) the second largest source. Of three projections providing figures for both nuclear power and coal at the end of the century, one estimates that coal will provide slightly more energy than nuclear, another estimates just the opposite, and one foresees a large margin for nuclear. Nuclear generation is expected to exceed hydroelectric generation sometime in the 1975-1980 period. In the case of individual fuels, the forecasts assume unlimited availability at no change in relative prices. This assumption seems of questionable validity even for the next decade.

26226

Perrine, Richard L. and Limin Hsueh

POWER AND INDUSTRY: CONTROL OF NITROGEN OXIDE EMISSIONS. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 9, 11p., Sept. 1, 1970. 32 refs.

When fossil fuels are burned with air some of the nitrogen reacts with oxygen forming nitrogen oxides; the major source of emissions of NOx in California is motor vehicles, but stationary power sources and others also contribute large quantities. The higher the peak combustion temperature the more nitric oxide is formed. Most current efforts to deal with the problem are centered on developing improved combustion processes and on the design of the burner and type of firing.

Some improvement may be obtained through combustion process modifications, but these are constrained by existing designs, stable operating requirements, and adverse secondary effects. Some basic approaches which have been developed for removal of NOx emissions from nitric acid plant stack gases include catalytic decomposition, catalytic reduction, absorption on solids, and caustic scrubbing. A number of modifications to operating conditions or burner design include low excess air combustion, flue gas recirculation, steam and water injection, burner configuration, and fluidized bed composition. The complex interaction of mixing, heat transfer, fluid mechanics, and chemical kinetics within the burner needs to be understood. Simplified models of the combustion process are necessary to aid in the understanding of the critical processes controlling nitric oxide formation and to provide a means for the systematic analysis of cause-effect relationships.

26233

Perrine, Richard L. and Limin Hsueh

POWER AND INDUSTRY: PARTICULATES. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 11, 3p., Sept. 1, 1970.

Industry is the leading producer of particulate emissions, while utility power plants are in second place. However, about 10% of the total airborne particulates result from construction and demolition, which are very difficult to control. Particle size range and the operating basis are cited for settling chambers, cyclones, wet scrubbers, filters, electrostatic precipitators, and afterburners. Precipitators able to operate at high temperatures are currently under development, but further research is needed to develop methods for removal of submicron particles.

26299

Tello Z., Joaquin

AIR POLLUTION ALONG THE MEXICAN-AMERICAN FRONTIER. (La contaminacion atmosferica en la frontera de Mexico con los Estados Unidos de America). Text in Spanish. Salud Publica Mexico, 12(2):195-198, March-April 1970. (Presented at the Asociacion Fronteriza Mexicana-Estadunidense de Salubridad, 28th Annual Meeting, Baja, California, March 16-20, 1970.)

If every city with 50,000 or more inhabitants is to be considered a potential source of dangerous air pollution, then there are 36 population centers adjacent to the Mexican-American border, 20 of which are air pollution threats. Of the 21 Mexican communities in this group, 12 have a population above 50,000. Pollution sources may be classified into four categories: automotive vehicles (which contribute 50% of the problem), generation of heat and electric power (15%), elimination of solid wastes, and industrial activity (30%). Only 58% of the electric power produced in Mexico is from hydro electric sources. Of the three communities on the border possessing thermoelectric generators, the largest is at Rosarito in Baja, California with a capacity of 307,000 kilowatts, operated in conjunction with an ocean water desalination plant at Tijuana. The other plants are at Rio Bravo in Tamaulipas (37,500 kw) and at Ciudad Juarez (15,000 kw). A study of the border conditions has le to some proposals, which include the formulation of criteria, acceptable to both countries, for the classification of pollutants and minimum tolerance, air quality standards, concerted action against the emission sources, common agreement as to the incineration of wastes, and agreement on the technological approaches to pollution control.

B. CONTROL METHODS

00107

S. S. Griswold

CONTROL OF STATIONARY SOURCES (TECHNICAL PROGRESS REPT. VOLUME 1). Los Angeles County Air Pollution Control District, Calif. Apr. 1960. 191 pp.

As a result of the intensive source control measures administered in Los Angeles County, Virtually all industrial operations have been brought within the scope of the air pollution control program. From the melting of metal to the painting of manufactured goods, specific industrial processes and equipment have been subject to air pollution control measures. This volume provides individual discussion of control techniques applied to the most significant stationary sources of air contamination. Certain source emission problems, such as those traceable to the operation of railroad locomotives and ships, are not discussed in this volume in view of the current unimportance of the source. The material reported in this volume generally contains only those developments occurring subsequent to the publication of the Second Technical and Administrative Report on Air Pollution Control in Los Angeles County, 1950-51. (Author)

00135

T. T. Frankenberg

REMOVAL OF SULFUR FROM PRODUCTS OF COMBUSTION. Proc. Am. Petrol. Inst. 45, (3) 365-70, 1965. (Presented at a Session on Desulfurization and Hydrogenation, 30th Midyear Meeting, American Petroleum Inst. Division of Refining, Montreal, Canada, May 12, 1965.)

A state-of-the-art paper is presented on various processes for removing sulfur from flue gas. Current efforts in environmental control stress the desirability of reducing sulfur dioxide emission. Four dry processes which utilize different methods and have different byproducts are discussed. All have unresolved problems, and none are economically feasible under current market conditions. Both capital and operating costs need to be drastically reduced. (Author)

00140

J. H. Fernandes, J. D. Sensenbaugh, and D. G. Peterson

BOILER EMISSIONS AND THEIR CONTROL. Combustion Engineering, Inc., Windsor, Conn., and Air Preheater Co., Wellsville, N.Y. (Presented at Conference on Air Pollution Control, Mexico City, Apr. 28, 1966.)

Emissions from combustion sources that are significant from the standpoint of air pollution include (1) particulate matter, (2) sulfur oxides, and (3) nitrogen oxides. Particulate matter is objectionable on esthetic grounds. The technology for its control well developed, although effort is constantly being made to improve collection equipment and reduce the cost of a nonproductive operation. Techniques have been developed for control of SO3 in oil-fired units by means of low-excess air and additives. Methods for control of SO3 in coal-fired boilers have not been as well developed as for oil-fired units, but there is less SO3 present with coal firing. A great deal of work has been done on control of SO2, both by fuel desulfurization and by removing the SO2 from the stack gas. Oxides of nitrogen are important as air pollutants because of their participation in the reactions leading to photochemical smog. Since the localities most subject to photochemical smog are in oil and gas burning areas, most of the work has been done on these fuels. The emission of oxides of nitrogen can be significantly reduced by using gas fuel or by use of a suitable firing method and low-excess air with oil fuel.

00205

PROMISE SEEN IN STACK-GAS SO2 REMOVAL. Oil Gas J., p.53, May 2, 1966.

Test programs under investigation in stack-gas SO2 removal are briefly reviewed. They involve the following: Babcock and Wilson is investigating a process involving injecting alkaline additives into the hot stack gases and then filtering them thru fiber glass filter bags. Monsanto Company is investigating a catalytic oxidation method. The process will remove sulfur dioxide from the flue gases by oxidizing it to sulfur trioxide and then condensing the latter to sulfuric acid. Although specifics are lacking, other companies (such as Isomax, H oil, and Gulf Oil Company) have been particularly active in the field of hydrodesulfurization of residual fuels prior to combustion.

00222

M. P. Silverman, M. H. Rogoff, and I. Wender

REMOVAL OF PYRITIC SULPHUR FROM COAL BY BACTERIAL ACTION. Fuel, Vol. 42, 113-124, Mar. 1963.

Incubation of the acidophilic iron oxidizing bacterium Ferrobacillus ferrooxidans with coal resulted in the removal of appreciable quantities of pyrite in three to four days. Bacterial action was most effective with small particle sizes of coal; more than 80% of the pyrite was removed in some cases. The relative ease of coal desulphurization followed the order bituminous easier than sub-bituminous easier than lignite owing to the acid neutralizing capacity of the lower rank coals. However, pretreatment with acid increased the susceptibility of all coals, except one lignite, to bacterial desulphurization. The addition of ferric sulphate increased pyrite removal from all acid-treated coals. A mechanism for pyrite removal by bacteria is discussed. (Authors' abstract)

00272

N. Glensy

MECHANICAL HANDLING OF COAL AND ASH. Eng. Boiler House Rev. (London), 81(6):170-177, June 1966.

Principal systems now available for coal and ash handling in small and medium-sized boiler houses are reviewed. Handling systems for the solid fuel and arrangements for extraction and disposal of ash are vital elements in the automatic operation of coal-fired industrial process boilers. Equipment suitable for removing ash are submerged conveyors, vibratory conveyors and pnrumatic handling plants. Submerged conveyors or draglink conveyors are widely used in large installations because they require little maintenance and have the advantage of being completely dust free. Systems can be designed to handle loads within the range from three-quarters of a ton to 20 ton/hr.

00276

A. F. Baker, A. W. Deurbrouck, and E. R. Palowitch

SULFUR REDUCTION THROUGH STAGE CRUSHING: USBM LOOKS AT METHOD TO EASE AIR POLLUTION FROM NORTHERN APPALACHIAN COAL. Mining Eng., 18(6):63-65, June 1966.

An analysis of the available data on sulfur reduction in coals by crushing is given. Crushing samples of the Pittsburgh and the Lower Kittanning coal beds to finer sizes before washing did not significantly reduce the sulfur content of the float 1.60 sp gr coal. Samples of the Upper and Lower Freeport coal beds showed significant sulfur reduction at each successive crushing stage. Crushing samples of the Upper Kittanning coal beds from 1 1/2 in. to 3/8 in. top size resulted in a significant sulfur reduction in a few samples, and further crushing to 14 mesh top size before separating at 1.60 sp gr resulted in a significant sulfur reduction in a substantial number of samples. The removal of the sink 1.60 sp gr material in the 1 1/2 in. top size coal reduced the sulfur content of many samples to less than 2%. In general, the sulfur content of the float 1.30 sp gr material remained essentially constant for each crushing stage.

00544

FUNDAMENTAL STUDY OF SULFUR FIXATION BY LIME AND MAGNESIA (FINAL REPORT.) Battelle Memorial Inst., Columbus, Ohio Columbus Labs. June 30, 1966, 50 p.

This study was undertaken to identify the basic factors involved in the capture of SO2 by limestone or dolomite added with the fuel or blown separately into the hot flue gas of central-station boiler furnaces. The report is in 3 parts, following a brief introduction: thermodynamic considerations, kinetics, and recommendations for use in the field. An extensive tabulation of the results of the many thermochemical calculations made during this study is included. Some of the results of this study can be summarized as follows: (1) Thermochemical calculations based on the best available data show that Ca0 is capable, theoretically, at equilibrium of removing all but 1 ppm of SO2 from flue gas at 1770 F; (2) With MgO, the temperature can be no higher than 1200 F for an SO2 level of 1 ppm at equilibrium; (3) Limestone or dolomite added with the fuel in pulverized-coal-fired boiler furnaces is apt to cause serious slagging problems, while the probable reaction of CaO with SiO2 furnace temperatures essentially may eliminate CaO as a means of capturing SO2 in hot flue gases carrying suspended coal ash; (4) For maximum effectiveness in coal-fired equipment, limestone or dolomite should be added at the point where the flue gas is no hotter than 2000F, probably at the entrance to the superheater sections; (5) The lower temperature limit where desulfurizing essentially would stop is not known, but 1000 F appears to be a reasonable temperature below which no further reactions may occur; and (6) Large amounts of limestone or dolomite would be necessary to remove SO2 from the flue gas of a typical boiler furnace. On the basis of stoichiometric calculations, about 230 tons of limestone would be needed daily to capture half the SO2 emitted by the boiler furnace of a 500 megawatt unit burning a fuel with 3% S.

00564

H. Perry

POTENTIAL FOR REDUCTION OF SULPHUR IN COAL BY OTHER THAN CONVENTIONAL CLEANING METHODS. Preprint. (Presented at the Symposium on Economics of Air Pollution Control, 59th National Meeting of the American Inst. of Chemical Engineers, Columbus, Ohio, May 15-18, 1966, Paper No. 24 E.)

Significant reduction of pyritic sulfur in coal requires, for most seams, crushing the coal to fine sizes in order to liberate the pyrite so that it can be separated from the coal. This requires that the coal be treated at the point of use since transportation of these fine sizes is expensive. Most conventional methods of treating coals to remove impurities do not appear to be suitable for sulfur reduction in these sizes. Treatment of the coal-pyrite mixture to enhance a physical or chemical property of the pyrite to make subsequent separation more efficient and less costly also does not appear to be competitive with removal of sulfur oxides from flue gases. There is insufficient information available as to the usefulness of concentrating tables for removing pyrite and additional research should be carried out in this field. (Author's summary)

00567

R. E. Zimmerman

THE ECONOMICS OF DESULPHURIZING COAL BY CONVENTIONAL COAL PREPARATION METHODS. Preprint. (Presented before the Symposium on Economics of Air Pollution Control, 59th National Meeting, American Inst. of Chemical Engineers, Columbus, Ohio, May 15-18, 19 6, Paper No. 24 D.)

This paper describes various methods for lowering the sulfur content of coal by removing pyrites or iron sulfides in the conventional coal preparation plants as well as suggested methods of preparation for maximum pyritic removal by combining the most efficient known processes. Estimated costs are given and converted to cents per million Btu.

00568

R. M. Jimerson

UTILIZING SOLVENT REFINED COAL IN POWER PLANTS. Chem. Eng. Progr. 62(10):53-60, Oct. 1966. (Presented at the Symposium on Economics of Air Pollution Control, 59th National Meeting of the American Institute of Chemical Engineers, Columbus, Ohio, May 15-18, 1966, paper no. 24 C.)

A process of dissolving coal, removing its ash and some sulfur, and reconstituting a uniform 'clean' fuel is described. The economic aspect of the process and the cost of reducing air pollution from powerplants by the substitution of 'clean' solvent refined coal for conventional contaminated fuels is estimated. The current and future possibilities and competitive market for solvent refined coal in the combustion field are developed. (Author's abstract)

00653

J. Kata

THE EFFECTIVE COLLECTION OF FLY ASH AT PULVERIZED COAL-FIRED PLANTS. J. Air Pollution Control Assoc. Vol. 15(11):525-528, Nov. 1965. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-131.)

The relationship between sulfur in coal, boiler exit gas temperature, and the carbon portion of fly ash has a major effect on the electrical properties of fly ash. Whether effective collection of fly ash is obtained by the electrostatic precipitator installation alone or the precipitator mechanical combination depends primarily on a knowledge of this relationship. Fly ash electrical properties can range from a highly 'resistive' to a highly 'conductive' state which can appreciably alter the precipitator collection performance. A correlation of coal sulfur and boiler exit flue gas temperature is given to indicate the probability of expecting an optimum voltage current relationship with different combinations of these factors. Carbon affects the electrical conditioning of fly ash by providing parallel paths of current leakage through the deposited dust layer. Therefore, removal of the carbon particles in a mechanical collector placed before the precipitator can alter the precipitator electrical characteristics. (Author abstract)

00687

F. Nelson and L. Shenfeld

ECONOMICS, ENGINEERING, AND AIR POLLUTION IN THE DESIGN OF LARGE CHIMNEYS. J. Air Pollution Control Assoc., Vol. 15(11):536-539, Nov. 1965 (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-144.)

A discussion of the methods used to determine the most economic design of chimney for a new thermal power station or large industrial plant is presented, with the objective that ground level concentration of pollutants will be kept at a minimum. Attention is paid to the geography and climatology of the site, with special reference to the frequency and height of inversions and the prevailing wind direction and speed. A method is illustrated in using a large thermal power station as an example. The maximum sulphur dioxide concentrations at ground level are computed for several chimney heights and gas exit velocities. The values of these sulphur dioxide concentrations, the capital cost of the chimney, the pumping costs, and the gas pressures within the chimney are considered in selecting a suitable chimney height and a gas exit velocity which will meet most economically the stated objective. The paper deals primarily with chimneys for industrial or power boiler plant of maximum continuous rating greater than 450 million Btu/hr (about 450,000 lbs of steam/hr), or to chimneys serving furnaces burning fuel at a maximum rate greater than 50,000 lbs/hr of coal, or 30,000 lbs/hr of oil. For chimneys serving plant with smaller heat inputs, chimney selection by reference to Clean Air Act 1956, Memorandum on Chimney Heights is suggested.

00975

M. I. Weisburd, (Compiler and Ed.)

AIR POLLUTION CONTROL FIELD OPERATIONS MANUAL (A GUIDE FOR INSPECTION AND ENFORCEMENT). Public Health Service, Washing- ton, D. C., Div. of Air Pollution, 1962. 291p.

Author discusses sources, control methods, training techniques and related aspects of air pollution. Document is an excellent source for specific information on equipment being used in air pollution control. Pictures, diagrams, schematics and charts are given.

01187

D. L. Kloepper, T. F. Rogers, C. H. Wright, and W. C. Bull

SOLVENT PROCESSING OF COAL TO PRODUCE A DE-ASHED PRODUCT. Gulf Oil Corp., Merriam, Kan., Spencer Chemical Division. Feb. 27, 1965. 469 pp. (Research and Development Rept. No. 9) CFSTI: PB 167809

This study shows that the ash can successfully be removed from coal using a process in which: (1) The coal is dissolved in the presence of hydrogen and using a solvent derived from the coal itself; (2) The coal solution is filtered to remove the undissolved mineral matter; and (3) The solvent is removed for recycle and the de-ashed product recovered. The dissolver area represents the heart of the process and while many variables need additional study, it has been shown on a gross basis that using approximately the same reaction conditions will result in essentially complete solution of a variety of coals. Hydrogen requirements are low and do not represent an economic problem. Mechanical problems plagued the filtration studies but it was possible to prove that well dissolved product filters readily and that ash values of approximately 0.1% can reasonably be expected for the final product. Preliminary studies on the use of a centrifuge to separate undissolved minerals from the coal solution were somewhat inconclusive. This study demonstrates that solvent is generated in the process and that recycled solvent retains its ability to dissolve coal. The use of solvent generated from the feed coal is a unique feature of the process. Solvent recovery and product solidification should not be problems in a commercial unit. A continuous unit was designed and built and technical feasibility of the process proven by simultaneous operation of all parts of the system. Since only small quantities of material could be made in this unit it was not possible to do more than very limited testing of the de-ashed product for the potential commercial applications in which it might be considered desirable. Widespread interest has been expressed in the product and many requests for materials to test could not be honored due to the substantial amounts needed for the testing programs. Market research has shown a potential market for the de-ashed product of over 72,000,000 tons annually. (Author summary modified)

01245

G. E. Johnson, L. M. Kunka, and J. H. Field

USE OF COAL AND FLY ASH AS ADSORBENTS FOR REMOVING ORGANIC CONTAMINANTS FROM SECONDARY MUNICIPAL EFFLUENTS . Ind. Eng. Chem. Process Design Develop. 4, (3) 323-7, July 1965.

Batch tests of coals and fly ashes were made to determine their effectiveness in removing organic contaminants from the final effluent of secondary-treated waste waters. The adsorptive capacity of fly ashes, coals of various ranks, and pretreated coals was determined and compared with activated carbon. The coals, though less active than carbon, are relatively inexpensive and can still be burned as fuel after use in waste-water treatment. Illinois No. 2 seam coal (hvcb) adsorbed about 4% of its weight of materials that consume oxygen (COD) in repetitive contacts with fresh sewage; activated carbon adsorbed about 10% of its weight of COD at the same test conditions. A fly ash removed 66% of the COD and 76% of the synthetic detergents (ABS) present in a single contact period. The effectiveness of fly ash as an adsorbent improves with increasing carbon content. Coals pretreated by mild oxidation were ineffective as adsorbents. (Author abstract)

01362

E.K. Diehl E.A. Zawadzki

CONTAMINANTS IN FLUE GASES - AND METHODS FOR REMOVAL. Coal Age, Vol. 70:70-74, Dec. 1965. (Presented at Technical Sales Conference, National Coal Association and Annual Meeting of Bituminous Coal Research, Inc., Sept. 1965.)

The relative importance of the harmful pollutants in stack gases from coal combustion is described. Polynucleai hydrocarbons, ocides of nitrogen, particulates, and sulfur oxides are considered. Sulfur dioxide removal methods are described.

01485

H. L. Engelbrecht

ELECTROSTATIC PRECIPITATORS IN THERMAL POWER STATIONS USING LOW GRADE COAL. Preprint. (Presented at the 28th Annual Meeting, American Power Conference, April 26-28, 1966.)

Author points out that based on present experience dust from firing systems which use low-grade coal can be successfully collected in electrostatic precipitators with a high collection efficiency. Influences and relations to such factors as flue gas velocity, collecting and discharge systems, sulfur content of coal, moisture content of the gas, effects of firing system, particle size distribution, and dust resistivity are delineated. It is concluded by author that correct design of new installations must be predicted on the knowledge which has been gained from installations now under operation.

01493

Squires, A. M.

AN INTRODUCTION TO THE HEAT CYCLE: A MEANS FOR ELIMINATING SULFUR FROM POWER-STATION EFFLUENT WHILE IMPROVING HEAT RATE. Proc. Am. Power Conf., Vol. 28, p. 505-515, 1966. 7 refs. (Presented at the 28th Annual Meeting, American Power Conference, Chicago, Ill., April 26-28, 1966.)

The Top Heat Cycle uses an oxygen flame to heat steam directly to temperatures beyond those which may be reached by indirect transfer of heat from hot flue gases to steam. For example, an oxygen flame might readily heat steam to 1500F, say. The limit is about 1250F when steam is heated indirectly by clean flue gas, and it is about 1100F when dirty flue gas ordinarily met with is used. Fuel to the oxygen flame should be clean and substantially free of sulfur. When power is to be generated from a 'dirty' fuel, such as heavy fuel oil or coal, a portion of the fuel is gasified with oxygen and steam to provide a rich fuel gas, which is cleaned of dust and sulfur compounds. Sulfur is recovered in the elemental form for sale. Oxygen for the cycle may be produced by conventional low-temperature plant. There is a good possibility of obtaining better results using an improved form of the historic Brin process in which oxygen was absorbed from air at high temperature by barium oxide. Equipment for a design using heavy residual oil; a survey of what the cycle might achieve; and development problems are considered.

01615

C.C. Shale

PROGRESS IN HIGH-TEMPERATURE ELECTROSTATIC PRECIPITATION. J. Air Pollution Control Assoc. 17, (3) 159-60, Mar. 1967. (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., June 20-24, 1966.)

Current-voltage relationships are given for a pilot-scale electrostatic precipitator with 3-inch electrode spacing at 80 to 1,500 F and 35 to 80 psig. Direct comparison is made with the electrical characteristics for a 4-inch spacing at 1,200 F over the same range of pressure. Experimental results on both spacings agree well with eklectrostatic theory. Initial dust removal efficiencies ranged from 90 to 96 percent at 1,460 F and 80 psig, but continuous operation was not achieved owing to excessive thermal expansion of the internal parts of the unit. Design modifications are discussed. (Author abstract)

01712

W. Weyers and L. H. Engels

THE RESULTS OF TECHNICAL MEASURES FOR DUST REMOVAL IN UNDERGROUND COAL PREPARATION AND THE ASSOCIATED CONVEYING PLANT. STAUB (English Transl.) 26, (1) 21-4, Jan. 1966.

Reports on the results achieved with technical methods of dust removal used in a coal preparation plant and an adjacent conveying plant are given; the results are illustrated by means of efficiency measurements which are described in detail. The strict requirements for dust removal in the plants have been fulfilled as a result of close collaboration of all the interested parties, so that the plant operation does not give rise to any objections as regards hygienic conditions. (Author summary)

01726

F. Johswich

THE PRESENT STATUS OF FLUE GAS DESULPHURIZATION. Combustion 37, 18-26, Oct. 1965.

The significance and practical possibilities of flue gas desulphurization were discussed by this author three years ago. New proposals have been added since then to the methods known and the subject of this paper is a technical and economical comparison of all methods. For simplification the comparison is based upon an oil fired steam power plant of which the design data are given. The following methods are discussed: The well known Reinluft and Penelec processes; the 'Wickert' method, which proposes an additive method which not only prevents low temperature corrosion in the boiler but also allows the oxidation of sulphur oxide in boiler flue gas. Laboratory studies have shown that pulverized dolomite which is blown into the furnace has a sufficient catalytic effect to oxidize the existing SO2 to SO3 thereby forming calcium and magnesium sulphate. The often suggested 'Wetwash' method is considered technically unsound. Tests made by German plants proved the technical impracticability of this method. The Double Catalysis method developed by Bayer Leverkusen, is not really a means for purifying flue gas but rather an improvement of the normal production method of sulphuric acid. A Ferro Oxyd' method is described although experiments were unsuccessful. The Aluminum-Oxide method by the Bureau of Mines and the German 'Stratmann' method which proposes to lead SO2 containing waste gas, e.g., flue gas through layers of active coal are also described. A technical evaluation of the latter process is given.

01727

Katell, Sidney

AN EVALUATION OF DRY PROCESSES FOR THE REMOVAL OF SULFUR DIOXIDE FROM POWER-PLANT FLUE GASES. Preprint, Bureau of Mines, Morgantown, W. Va., Morgantown Coal Research Center, ((23))p., 1966. 8 refs. (Presented at the 59th National Meeting, American Institute of Chemical Engineers, Symposium on Economics of Air Pollution Control, Columbus, Ohio, May 15-18, 1966.)

An economic evaluation of new methods for removing sulfur dioxide from powerplant flue gases is presented. Considered are processes under development or proposed for development in the United States. Capital and operating costs are established for an 800-megawatt powerplant and these costs expressed both as dollars per kilowatt of installed capacity and dollars per ton of coal feed. The operating costs are based on an assumed 90 percent operating factor for the powerplant. The change in costs introduced by considering an operating factor of 50 percent is also shown. (Author's abstract)

01796

P. Sporn T.T. Frankenberg

PIONEERING EXPERIENCE WITH HIGH STACKS ON THE OVEC AND AMERICAN ELECTRIC POWER SYSTEMS. Nat. Soc. Clean Air, Proc. Ann. Conf. (An Expanded Version was Presented at the International Clean Air Congress, London, England Oct. 4-7, 1966.) 7 pp. (Also published in: The Tall Stack for Air Pollution Control on Large Fossil-Fueled Power Plants, p. 34-42, 1967)

The two Ohio Valley Wlectric Corporation plants with capacities of 1200 and 1000 MW were pioneering ventures in many ways. During their design stage, the ten largest thermalelectric plants operating in the United States had an average size of less than 600 MW. By 1963 there were 17 plants in operation, each exceeding 1000 MW. The wind tunnel work and gas diffusion calculations leading to the selection of 683 foot stacks for the larger plant and 535-foot for the other is described. Dustfall and SO2 concentration studies in the field began prior to operation and continued for three years after full commissioning of the plants. Data obtained were used in evaluation of the diffusion equations, and to judge the correctness of certain mathematical models covering transient situations. Experience obtained in operating and maintaining these pioneer stacks led to modifications in the design of the 825-foot stacks for Cardinal Plant near Brilliant, Ohio which will be commissioned in 1966. (Author abstract)

01799

THE DISPOSAL OF COAL REFUSE. J. Air Pollution Control Assoc. 6, (2) 105-10, Aug. 1965 (Technical Coordinating Comittee T-4 Coal Report.)

Fires are of general occurrence in bituminous refuse piles because their construction is such that the air flow falls within the critical range. This construction is a normal characteristic of aerial tram, incline, larry, and careless tuck disposal operations. As such piles become higher, size segregation, void space between larger pieces, erosion cuts, settlement, and the development of slip page fissures enable restricted upward circulation of air. This chimney effect within the pile promotes spontaneous heating and ultimate combustion of the refuse pile. Many coal operators have found that by observing proper care in the selection of dump sites and the methods of disposal, the occurrence of refuse fires can be eliminated. Such practices in pile construction as compaction by roller in thin layers, crushing the larger pieces to an intermediate size, reducing the pile slope, and the use of a terraced face will reduce spontaneous ignition and permit control of fires in unsealed piles. For even better protection against refuse pile fires, some operators have sealed the piles with clay or fine refuse. This procedure is very suitable for hillside sites because the hillside reduces the exposed edge area and clay is available for the seal at the rising pile level. Methods have been developed whereby existing refuse-pile fires can be extinguished. Water can be used to cool areas to be extinguished, but the use of water to stop the fire has not been successful. Satisfactory results have been obtained by sealing the burning pile with compacted refuse, cleaning plant sludge, or refuse fines. (Author abstract)

01866

R.A. Glenn R.D. Harris

LIBERATION OF PYRITE FROM STEAM COALS. J. Air Pollution Control Assoc. 12, (8) 388-95;404, Aug. 1962. (Presented at 23rd Annual Meeting, American Power Conference, Chicago, Ill., Mar. 21-23, 1961.)

This paper presents a discussion of research being conducted to expand knowledge of the nature and mode of occurrence of pyrite in coals in an effort to gain information which will enable the development of new or improved methods for reducing the sulfur content of coals to levels below that now attainable by conventional coal cleaning techniques. Application of modern microscopic and chemical techniques in the characterization of a group of selected high sulfur bituminous coals has shown that the major portion by weight of the pyrite present exists as particles large enough to be readily separated once they are liberated. Laboratory test results indicate that during pulverization the pyrite tends to concentrate in the various particle-size fractions. The microscopic pyrite particles embedded in the coal substance tend to concentrate in the very fine fractions, that is, fractions below minus 200 mesh. The larger pyrite particles that are associated with the mineral matter tend to concentrate in the greater-than-60 mesh fraction. However, for the full benefits of these results to be realized in commercial practice, much additional research will be necessary to develop practical pulverizing machinery and techniques. Where the pyrite sulfur is mainly associated with mineral matter, there are good prospects of its removal by adapting presently the organic matter will require the development of improved equipment for processing coal in the minus 200 mesh size. (Author summary)

02032

K. Schwarz

(DUST EMISSIONS FROM COAL-FIRED BOILERS IN THE FEDERAL REPUBLIC OF GERMANY.) Die Staubemissionen Kohlegefeuerte Dampfkesselgrossanlagen in Der Bundesrepublik Deutschland. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper V/8). pp. 136-41.

In the Federal Republic of Germany, rigorous scales were evolved for the supervision of emissions from industrial plants by the Federal Regulations issued in 1959 in the interests of clean air, and by the technical regulations of 1964, which set limits for these ('Technical Directions for Clean Air, TAL'). This applies in particular for the requirements which were placed on the emission of dust from large coal-fired boilers particularly when the fuel has a high ash content. Results of numerous experiments on large, electric dust removers for bituminous coal and brown coal-fired boilers - carried out by the Technical Supervisor Groups in Essen and the Rheinland, show the developments over the past few years towards ever higher separating achievements. Effects of various factors, in particular the properties of the fuel and the combustion conditions , were visible on dust properties and separating results. The limits reached today in this sector are indicated. (Author abstract)

02036

G. G. Schneider

INTERNATIONAL DUST AND FUME COLLECTION PROBLEMS. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper V/12). pp. 149-53.

A general review is presented of problems which affect many nations. The need for larger and more efficient units, the application of electro-filters, legal emission limits, the nomenclature problem, new techniques which have responded to new problems, and international financial arrangements are discussed.

02053

F. Oels.

PRESENT STATE OF DEVELOPMENT OF FLUE-GAS DESULPHURIZING INSTALLATIONS IN NORTH-RHINE WESTPHALIA. Stand Der Entwicklung Von Anlagen rzur Entschwefelung Von Abgasen Im Land Nordrhein-Westfalen. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/17). pp. 206-8.

In support of development of flue gas desulphurization installations by the State of Northrhine-Westfalia dry processes for desulphurization of hot flue gases are being preferred. According to the Reinluftprocess a plant with a capacity of 55,000 N cum/h in a chemical factory is being started up. This installation is coupled with a sulphuric acid plant, a Claus oven plant, and an oil burning installation. Another plant of this type with a capacity of 33,000 N cum/h is being erected in connection with a pitcoal power station in order to test the process with different kinds of furnaces. At the same power station another desulphurization process is being tested (Wickert process) blowing lime or dolomite into the boiler. Finally at a coal-fired power station another desulphurization plant has to be erected using absorption of sulphur dioxide on wet lignite coal filters ash (Still-process). (Author abstract)

02149

(THE PRESENT ASPECT OF PUBLIC NUISANCE PREVENTION CONTROL IS THE ELECTRICITY SUPPLY ENTERPRISE IN JAPAN.) Clean Air Heat Management (Tokyo) 15, (3) 6-8, Mar. 1966.

Due to the rapid growth of industry, limited land, and extreme localization of industry, public nuisance has become a serious problem in Japan. Among various kinds of public nuisance, air pollution due to SO2 is most closely related to the electric power supply industry. The recent switch of fuel in industry from coal to petroleum caused the increase of SO2 in air to such an extent that in Yokkaichi the SO2 content in air exceeded 0.2 ppm and resulted in a serious social problem. In order to control the situation, the electric power supply is taking the following measures: use of high-efficiency dust collector and effective combustion control system; building of high stacks; use of low sulfur petroleum. The following methods for reducing SO2 are described: use of additives (CaCo3 or dolomite powder) and sulfur removal using hydrogen or bacteria.

02192

F. E. Gartrell and J. C. Barber.

POLLUTION CONTROL INTERRELATIONSHIPS. Chem. Eng. Progr. 62, (10) 44-7, OCT. 1966.

Authors conclude that air pollution control and water pollution control in industrial applications are closely related. Discussed are the TVA experience with coal-fired power palnts and phosphate fertilizer plants which indicates that application of one type of pollution control ultimately must include consideration of the other. General aspects of the control equipment (to control fly ash emissions) utilized in the TVA coal-fired power stations are discussed.

02195

S. Katell.

REMOVING SULFUR DIOXIDE FROM FLUE GASES. Chem. Eng. Progr. 62, (10) 67-73, OCT. 1966.

The removal of sulfur from ocal prior to its utilization as a power plant fuel is investigated. An economic evaluation of new methods for removing SO2 from power plant flue gases is presented. Processes under development or proposed for development in the U.S. are considered. Estimated capital investment and operating costs for 3 dry processes for removing SO2 from flue gases are projected for an 800-Mw. power plant burning 3% sulfur coal.

02206

K.S. Watson K.J. Blecher

FURTHER INVESTIGATION OF ELECTROSTATIC PRECIPITATORS FOR LARGE PULVERIZED FUEL FIRED BOILERS. Intern. J. Air Water Pollution, 10, (9) 573-83, Sept. 1966, (Presented at the Second Technical Session, 1965 Clean Air Conference, Australia, Aug. 19, 1965.)

Collection difficulties experienced with New South Wales fly ash appear to be related to the area from which the coal is mined and dust from at least one south coast mine is markedly more difficult to precipitate than dust from Northern seams with dust from the Western fields being intermediate in difficulty of collection. Flue gas conditioning with ammonia has been found moderately successful at Tallawarra where it is now permanently used on two 100 MeW installations. Evidence of the effect of gas conditioning on the electrical behaviour of the precipitator is given. The relationship between migration velocity and gas temperature has been confirmed except at Vales Point where a temperature variation of 100 F has no perceptible effect on precipitator performance. The existence of performance bands due to factors external to the precipitator has been confirmed and quanititative data on rapping intensities are available. Accurate measurement of resistivity has been found to be difficult and the value of resistivity measurement as a means of comparing dusts is doubtful. (Author abstract modified)

02311

G.N. Stone A.J. Clarke

POWER STATIONS AND CLEAN AIR. Central Electricity Generating Board (England) 1963. 12 pp.

This paper discusses the chimney emission problems presented by power stations and the techniques developed for dealing with them. Study of chimney plume behavior, instruments developed to assist in research, and research into dry sorption processes for removing SO2 from flue gases, are reviewed.

02398

G. Stabenow.

SURVEY OF EUROPEAN EXPERIENCE WITH HIGH PRESSURE BOILER OPERATION BURNING WASTES AND FUEL. Proc. Natl. Incinerator Conf. 144-60, 1966. (Presented at the National Incinerator Conference, American Society of mechanical Engineers, New York City, May 1-4, 1966.)

A number of large incinerators in European municipal service have stoker-fired water-walled furnaces and boilers for power generation. The paper discusses the principles, stoker design, burning rates, boiler design and high efficiency dust collection. Data on nine European and two Brazilian plants of European design are given. Water-walled furnaces allow the use of low excess air, which reduces the volume of flue gas to be cleaned. (Author abstract)

02407

D. Bienstock, J.H. Field, J.G. Myers

PROCESS DEVELOPMENT IN REMOVING SULFUR DIOXIDE FROM HOT FLUE GASES. I. BENCH-SCALE EXPERIMENTATION. Bureau of Mines, Washington, D.C. (Report of Investigations 5735). 1961. 34 pp.

This report is the first of a series of four publications by the Bureau of Mines on the engineering development of a process for removing sulfur dioxide from flue gases. Later reports will cover the design and operation of a small-scale, pulverized coal fired furnace, pilot plant investigations, using flue gases from the furnace, and cost estimates for a commercial installation. The following subjects are discussed in this report: Problem of sulfur dioxide pollution. Magnitude of sulfur dioxide pollution. Legislation regarding sulfur dioxide. Methods of reducing sulfur dioxide pollution. Operating procedure. Absorption. Alkalized alumina absorbent. Effect of alkali, sulfate, water vapor. Regeneration of spent sodium alumina absorbent. Proposed industrial application for scrubbing flue gas. Manganese oxide absorbent. Electrolytic regeneration of manganese sulfate; Adsorption. Activated carbons. Molecular sieves. Oxidation catalysts. Future studies.

02408

J.D. Spencer

BUREAU OF MINES RESEARCH AND TECHNOLOGIC WORK ON COAL, 1964. Bureau of Mines, Morgantown, W. Va., Morgantown Coal Research Center 1965. 125 pp.

This report describes the 1964 research activities of the Bureau of Mines, and the results obtained in mining research, coal storage and preparation, and others. Research on synthetic fluid fuels and chemicals production from coal, an important potential use of the solid fuel, continued to be stressed by the bureau. The production of synthetic pipeline gas, a natural gas substitute, for example, was the subject of much study including coal gasifications, gas purification and gas processing research. Work done by the Bureau on stack gas purification, in connection with the control of air pollution, is also reviewed.

02424

E.V. Somers, J.R. Hamm, N.E. Weeks

CONCEPTUAL-DESIGN STUDY: COAL-FIRED GAS-TURBINE POWER PLANT WITH SO2-FREE FLUE GAS. Westinghouse Research Labs., Pittsburgh, Pa. (Scientific Paper 66-1DO-HCONS-P3.) Aug. 22, 1966. 18 PP.

The coal-fired combined gas-steam turbine power plant studied appears capable of producing electrical energy at costs competitive with that produced by coal-fired and nuclear steam plants. The plant is cost competive for electrical energy in plant sizes as low as 100 MW. Removal of the sulfur in the high pressure gasification system affords better than 90% reduction in SO2 in the flue gas. The cooling water requirement for the combined cycle plant is about 40% of that for a coal-fired steam plant. The components used in the technical-economic study are either in existence or are small extrapolations of known design technology. The plant is based on 'near-term' equipment. There remains considerable growth potential for reduced electrical energy costs because of possible improvements in plant components. Development of gasifiers to handle all run-of-mine coal, including strongly caking coals, and of gas turbine capable of operating at higher temperatures promises additional economic gains for coal-fired electrical energy. (Author abstract)

02442

G. R. Frysinger

A HYDROCARBON-AIR FUEL CELL USING AN ACID ELECTROLYTE. Army Engineer Research and Development Labs., Fort' Belvoir, Va., Electrical Power Division. 11 pp., June 1966 CFSTI,DDC AD 634677

The utilization of liquid hydrocarbon fuels in a fuel cell to produce electrical power is of high practical interest. The ability to utilize the liquid hydrocarbon fractions available from conventional petroleum refineries at energy conversion efficiencies of 40-60% has the effect of greatly increasing the usable energy content of our proven petroleum resources. A new fuel cell concept which utilizes a phosphoric acid electrolyte offers a highly compact fuel cell assembly which can be used in a very highly simplified system for the generation of d. c. electrical power from hydrocarbon fuels. Either the hydrocarbon can be reached directly at the electrodes in an anodic oxidation reaction or the active hydrogen of the hydrocarbon molecules can be liberated by a hydrocarbon-stem reforming reaction and the hydrogen subsequently reacted at the fuel cel anode. The objective of this paper is to describe the electrode processes involved in each of these alternatives and to discuss the hydrocarbon-air fuel cell system which is now possible, based on the recent achievements from U.S. Army research investigations. (Author abstract)

02727

R. F. Bovier

SULFUR - SMOKE REMOVAL SYSTEM. Preprint. (Presented at the 26th Annual American Power Conference, Chicago, Ill., Apr. 16, 1964.)

Development of an economically feasible system for essentially eliminating all solids and most sulfur fumes discharged into the atmosphere while burning high ash, high-sulfur content bituminous coal in power plant boilers may solve one of our industry's oldest and most vexatious emission problems. The problem, of course, is how to effectively minimize or control the stack emission of fly ash and sulfur dioxide. The new system, as developed through actual pilot plant operation, not only promises to successfully eliminate one of the remaining major emission problems associated with the burning of soft coal, but actually produces sulfuric acid of acceptable qualities and in quantities substantial enough for economic commercial use. The purpose of this paper is to describe the unique system, and how it came about, to explain how it functions, to point out why it appears to be economically feasible, and to indicate its value as an additional major tool for improving the quality of atmospheric conditions in the vicinity of large, new, coal-burning electric generating stations.

02772

V. H. Sussman J. J. Mulhern

AIR POLLUTION FORM COAL REFUSE DISPOSAL AREAS. J. Air Pollution Control Assoc. 14, (7) 279-84, July 1964. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

Large quantities of coal refuse are produced during coal minimg and cleaning operations. The refuse is deposited in large piles often containing millions of tons of highly pyritic coal. The piles often ignite (either spontaneously or through carelessness) and the burning refuse emits large quantities of oxides of sulfur and hydrogen sulfide. High concentrations of these gases have been measured in communities adjacent to burning piles. There are many of these burning piles in Pennsylvania and a recent survey by the U.S. Bureau of Mines indicates that a number of other states have similar problems. The air pollution problem caused by these burning piles was given a high priority by the Pennsylvania Air Pollution Commission. The Commission's first Regulation is entitled 'To Prevent and Control Air Pollution From Coal Refuse Disposal Areas'. This paper describes the nature of this air pollution problem, abatement and control methods and the regulatory procedures employed by the Pennsylvania Air Pollution Commission. (Author abstract)

02778

B. H. M. Billinge, A. C. Collins, B. Hearn, and H. G. Masterson

THE DRY REMOVAL OF SULPHUR DIOXIDE FROM FLUE GASES. Cost Estimates. Preprint. 1963.

First Order Estimates have been made of the cost of removing sulphur dioxide from the flue gases produced by a 4,000 MW station, considering two alternative dry removal processes, one based on carbon and the other on alkalized alumina as the solid absorbent. On the basis of the estimates made in this report it has been shown that both processes are economically attractive, subject to the confirmation, by further research, of a number of primary cost factors. In the light of present knowledge the estimated costs of the two processes, for removal of 50% of the sulphur dioxide, are given. Despite the slight differential in costs between the two processes it appears that the alkalized alumina process would be the more probable one for power station use. (Author summary modified)

02813

K. E. Yandon

POTENTIAL MARKET FOR DE-ASHED COAL AND ITS BY-PRODUCTS FOR A PLANT LOCATED IN WASHINGTON STATE. Preprint. Feb. 1965.

The potential market for the de-ashed coal product, developed by the process from Spencer Chemical Company, for a plant located in Washington would have a market range from 3.4 million tons to 10.5 million tons. If we included the possibility of the by-products entering the petroleum refinery complex, we could add 1 million tons to 4.8 million tons, or have an over-all grand total ranging from 4.4 million tons to 15 million tons. A table shows a summary of the potential market that de-ashed coal and its by-products could enter from a plant located in Washington. The total amount of diesel oil consumed by the railroads for the market area designated is reported. Also reported is the total for all uses of diesel oil. The 1961 figure for exports to Japan of petroleum coke and carbon black are only the amounts that were exported from the U.S. and not from other sources. (Author abstract)

02908

D. Bienstock, J. H. Field, and J. G. Myers

REMOVAL OF SULFUR OXIDES FROM FLUE GAS WITH ALKALIZED ALUMINA AT ELEVATED TEMPERATURES. J. Eng. Power 86, (3) 353-60, July 1964 (Presented at the ASME-AIEE National Power Conference, Cincinnati, Ohio, Sept. 22-25, 1963.)

A cyclic process is described for removing the oxides of sulfur from flue gas by absorption of 625 F and then converting the oxides to elemental sulfur by reduction of the spent absorbent. Pilot-plant experiments are reported in which a solid absorbent of alkalized alumina in free and baffled fall is used to remove SO2 and SO3 from the combustion gas of a pulverized coal-fired furnace. The absorbent is then regenerated by heating with hydrogen or with steam-reformed natural gas. Flyash does not interfere and attrition is negligible. (Author abstract)

02909

R. V. Bins

AIR POLLUTION CONTROL SYSTEM AT BAY SHORE GENERATING PLANT OF THE TOLEDO EDISON COMPANY. Air Eng. 8, (5) 20-2;24, May 1966.

In the complex of equipment to generate electricity for northwestern Ohio, the boilers at the Bay Shore Power Plant consume daily an average of 53 railroad cars of coal. Without the station's existing air pollution control equipment, the daily consumption of 3,200 tons of coal could cause a great deal more air pollution than what is now emanating from the 250-foot tall chimneys. Somewhat more than one half million dollars has been invested for pollution control equipment and auxiliaries at the Bay Shore Station. Air Pollution control has become more effective and efficiency has grown and will continue to do so with advancement in engineering technology.

02931

D. Korol

SEPARATION OF PYRITES FROM COALS. (Wydzielanie pirytu z wegli.) Prace Glownego Inst. Gornictwa (119)1-12, 1952. CFSTI: 60-21277

The objects of this investigation were to study the possibility of separating by means of mechanical processing at least part of the sulfur contained in Polish coals; to earmark those collieries which possess S in such quantities as to make feasible an industrial separation of pyrite from coal; to establish the technological approach. Only pyrite coal is considered herein. The use of the sulfur obtained from pyrites by the chemical industries is considered most desirable. Products totalling 69 from 26 collieries were examined as follows: (1) by jigging, (2) by enrichment of products on concentrating tables (considered the most appropriate approach); (3) enrichment by flotation, mostly applicable to slurries. It was established that, by treatment on concentrating tables, pyrite concentrates of S content above 40% can be obtained from the product of certain collieries; in other collieries, the concentrates separated contained from 35 to 40% S, or lower. Priority should be reserved for the construction of small preparation plants, equipped with tables, attached to collieries which yield, without additional processing, rich pyrite concentrates.

02970

H. Juntgen and W. Peters

TECHNICAL PRINCIPLES OF SEPARATING SO2 FROM WASTE GASES. Staub (English Transl.) 25, (10) 60-5, Oct. 1965. CFSTI: TT 66-51040/10

Sulphur removal methods used at present are based on the separation of flue gas sulphur in the form of SO3, sulphuric acid or sulphate. These methods require, therfore, oxidation of the SO2 present in flue gas. It is possible to carry this out in the gas phase on vanadium, and subsequently to separate the sulphuric acid formed. If adsorbents containing carbon are used, the conversion to H2SO4 occurs at the inner surface of absorbent in the presence of water and oxygen. The absorption agent can be regenerated either by washing or by reducing the sulphuric acid with absorption carbon at 350 to 450 C. It has been proposed, under certain conditions, to separate SO2 as metal sulphate by means of reaction with alpha-Mn2O3, alkalized aluminum oxide, alpha-Fe2O3 and dolomite. (Author summary)

02971

G. Heinrich

PRACTICAL EXPERIENCES IN REMOVING SO2 FROM EFFLUENTS OF EXPERIMENTAL AND OPERATING INSTALLATIONS. Staub (English TRANSL.) 25, (10) 65-75, OCT. 1965. CFSTI TT 66-51040/10

The extent of sulfur dioxide emissions in various branches of industry is given and it is shown that the power industry essentially affects these emissions. Since sulphur removal from fuel is technically difficult and expensive, the desulphurization of flue gas at main emission points is the only solution to the problem. Known methods for flue gas desulphurization are described and compared, and subsequently some of the processes tested in pilot plants and on industrial scale are explained in detail. Numerous data are given on washing methods with limewater (Battersea) and water (Duisburger Kupferhutte), and on the adsorption method using semi-coke (Reinluft-method). (Author Summary)

02974

W. Thieme

MEASURES FOR REDUCING EMISSION FROM DOMESTIC HEARTHS USING SOLID FUELS. Staub (English Transl.) 25, (11) 10-3, Nov. 1965. CFSTI TT66-51040/11

Fly ash, fly coke, soot and carbonization vapours and also gaseous products are formed during combustion of solid fuel. Emission measurements have shown that the solid matter present in flue gas from domestic hearths consists mainly of low-temperature carbonization products. Their amount decreases with increasing volatile matter content. Coal of a low matter content, or ovens with a special arrangement for the combustion of carbonization gas should be used to reduce the emissions. A universal permanent burner has, therefore, been developed which permits a considerable reduction in smoke emission to be achieved. (Author summary)

03045

H. Mori

HANSHIN WET TYPE DUST COLLECTORS. Clean Air Heat Management (Tokyo) 15, (5) 5-11, May 1966

There are three models of Hanshin Wet Type Dust Collectors for collecting different kinds of dust and they all operate on the same principles. Contaminated exhaust gas is forced into a water tank equipped with turbulance control plates through nozzles at a high speed. The gas is cleaned while in contact with the water. The HJ model is for collecting fine particles from such materials as sand, cement, activated carbon and brick. The typical collection efficiency for various particle size distributions is approximately 99%. The HJS model is designed for use with oil and coal burners. The mechanics of this model are the same for the HJ models, but the HJS model requires the addition of a sludge tank. The concentration of soot in the exhaust gas is reduced by a factor of two. Appropriate sizes of HJS models for different boiler sizes are tabulated. HJG models are designed for the treatment of gaseous contamination in exhaust gas. They have the same structure as HJ and HJS models except that a de-mister is added at the top of the tank. The absorption efficiencies for H2S, Cl2, SO2 and NO2 are tabulated. The efficiency of 98.5% is obtained for H2S by addition of NaOH to the tank water.

03053

G. A. W. Van Doornum.

SMOKELESS COMBUSTION OF BITUMINOUS COAL. Coal, Gold, and Base Minerals of S. Africa 14, (7) 32-3, 37, Sept. 1966.

Smokeless combustion of bituminous coal is possible in small industrial furnaces, boilers and domestic installations. In order to burn the tar fumes resulting from the primary decomposition of coal, a secondary source of oxygen must be mixed thoroughly with the fumes and the combustion temperature must be at least 700C. Two examples of methods for achieving this are discussed. One consists of a combustion chamber which can be incorporated into a variety of appliances; the other involves the use of a nozzle to produce a tangential airjet in a hand-fired vertical boiler.

03232

G. W. Thom and A. F. Schuldt

THE COLLECTION OF OPEN HEARTH DUST AND ITS RECLAMATION USING THE SL/RN PROCESS. Can. Mining and Met Bull. (Montreal) 59, (654) 1229-33, Oct. 1966

The authors describe the dust collection system for iron oxide dust from the basic oxygen hearths using electrostatic precipitators, then removing the zinc and lead oxides and sulfur compounds by direct reduction in a rotary kiln using the SL/RN Process. (SL/RN designates the two groups of companies who developed the process.) In this process bentonite is added to the dust to form green balls. Then dolomite and anthracite were added to the balls which were fed into the kiln. The coal acted as a reductant and also provided energy. The dolomite removed released sulfur. The results of kiln tests are presented.

03337

Beinstock, D., Brunn, L. W., Murphy, E. M. and Benson, H. E

SULFUR DIOXIDE - ITS CHEMISTRY AND REMOVAL FROM INDUSTRIAL WASTE GASES. Bureau of Mines, Washington, D. C. (Information Circular 7836.) 1958. 101 pp.

More progress had been made in removing SO2 from flue gases by gas-washing processes than by other techniques. The developed processes include the Battersea, the Howden-I.C.I. cyclic lime, the basic Al2(SO4)3 I.C.I., the Lurgi 'sulfidine', the Fleming and Fitt dimethylaniline, the ammoniacal liquor, the Johnstone and Singh Na2SO3, and the Mg(OH)2 system. A major disadvantage common to all these wet absorption processes is that cooling of the gases occurs; the scrubbed gas, which still contains some SO2, loses its buoyancy and may settle in the immediate vicinity of the plant. No commercial methods based on adsorption have been developed for removing SO2 from flue gases. However, the use of an adsorption process is conceivable, and fundamental data for adsorption of SO2 on C, SiO gel, Pt, and on the oxides of A, Fe, and V are presented. Reduction of SO2 with gaseous reactants, H2, H2S, CO, and CH4 occurs at commercially feasible rates and temperatures. Reduction products include S, H2S, and CS2. Several commercial processes are based on these methods. Reduction of SO2 with C in the form of coke and anthracite has also been practiced on a laboratory and plant scale. SO2 may be oxidized to SO3 with air or oxygen in the presence of a catalyst as in the contact-acid process, or with O3, light, or electrical discharge. Basic metallic oxides in the solid phase might serve as effective absorbents of SO2 at flue-gas temperatures. Sulfates formed in the absorption could be electrolyzed for recovering S as H2SO4 and for regenerating metallic oxide. Electrolytic recovery would be desirable at a powerplant installation, where electrical energy is available at a low cost. Thermal decomposition of sulfates could also be employed and SO_2 or SO_3 recovered. Sulfites formed in the absorption also could be thermally decomposed or oxidized with air to the sulfate. The Bureau has considered removing SO_2 from flue gases by develloping absorption processes, which could be conducted at flue-gas temperatures in order to prevent loss of buoyancy of the flue gases. Several possible methods, including both solid-phase and gas-phase reactions, are suggested as hot-absorption processes.

03581

D. Bienstock and E. M. Murphy

THE CHEMISTRY OF SULFUR DIOXIDE (INTERIM REPORT). Bureau of Mines, Bruceton, Pa. 1956. 63 pp.

This document was prepared to serve as an annotated bibliography to orient the early thinking of personnel actively engaged in a cooperative project undertaken by the Bureau of Mines and Public Health Service for the development of processes aimed at the removal of SO_2 from effluents. Subject matter includes material on the chemistry of SO_2, gas purification processes, and reactions which may be of potential value to the objective of SO_2 control. Specific subjects include the following: Absorption (absorption and regeneration mechanisms, effluent processes (Battersea-Thames River), non-effluent (cyclic) processes (use of lime, ammoniacal solutions, sodium sulfite-bisulfite, basic aluminum sulfate, use of amines - Lurgi sulfidine process, Asarco process); Adsorption (on C, silica gel, pt and the oxides of Cr, Fe and V); Reactions with oxides (oxides of Al,Ca,Cr,Fe and Sn); Reduction with metals (Fe, Mg, Ni); Reduction with gases (H_2H_2S, CO-Bolidens process-Trail process, methane - Thiogen processes-Asarco process); Reduction with carbon; Electrolvsis of sulfur containing compounds.

03879

W. A. Pollock, G. Frieling, and J. P. Tomany

SULFUR DIOXIDE AND FLY ASH REMOVAL FROM COAL BURNING POWER PLANTS. Air Eng. 9(9), 24-8 (Sept. 1967). (Presented at the Winter Annual Meeting and Energy Systems Exposition, American Society of Mechanical Engineers, New York City, Nov. 27-Dec. 1, 1966.)

A wet scrubber system is described for the removal of sulphur dioxide and fly ash from coal burning power plant flue gases. The scrubber utilized was the Turbulent Contact Absorber (TCA) as designed and manufactured by UOP Air Correction Division. A TCA pilot scrubber was operated at the Oak Creek plant of the Wisconsin Electric Power Company during 1964. Results indicated that, with a sodium carbonate solution as the scrubbing liquid, an absorption efficiency of 85 percent for sulphur dioxide and a collection efficiency of 98 percent for fly ash were obtained. Operating pressure drops for these conditions were in order of 4 in. wg. Also described are separate tests in which limestone additions were made to the coal prior to pulverizing and burning in a central station boiler. The effect on furnace conditions and the extent of removal of sulphur dioxide in the flue gas were evaluated. A test with limestone addition in combination with a TCA scrubber needs to be evaluated. Both the advantages and limitations of this scrubbing system and the limestone additive, as well as a general feasibility study for full scale exploitation, are discussed. (Author abstract modified)

03974

L. M. Exley, A. E. Tamburrino, and A. J. O'Neal, Jr.

LILCO TRIMS RESIDUAL OIL PROBLEMS. Power 110 (4) 69-73, Apr. 1966.

After several years of experimentation, Long Island Lighting Company has developed an economical and practical method for reducing the major problems associated with residual fuel oil. These problems are periodic acidic stack emissions and high-and low-temperature corrosion on the gas side of the equipment. Not only have all these been brought under control, but the methods employed have yielded surprising additional benefits, with economic return exceeding the cost of control. Control was obtained through a combination of low excess air operation and the injection of finely-sized magnesium oxide as an additive into the oil. The problems involved six tangentially-fired reheat boilers that were commissioned between 1952 and 1963, located in four separate stations. The boilers are fired with oil at least part or the time. Some are fired with natural gas and oil, while others are fired with natural gas and coal, separately or in combination. Numerous field investigations have been conducted concerning stack emissions and internal corrosion. LILCO's successful control of residual oil-burning problems through low excess air and finely-sized MgO additive has shown the following: (1) The efficiency of the oil-fired boilers is raised by at least 1% through lower excess air, resulting in lower stack losses. Cycle efficiency is improved through higher superheat and reheat temperatures. (2) Boiler reliability is improved. (3) Stack emissions are under good control, thus improving company-community relations. (4) The value of the vanadium byproduct is equal to at least 1.5 times the cost of the additive. (5) Maintenance costs are substantially reduced. Air heater fouling, for example, is reduced to the point where washing is done only during annual inspections. (6) Boiler and flue gas systems are free of slimy, acidic and odorous deposits. They are, therefore, less hazardous for maintenance personnel. (7) There is reason to believe that the coating on furnace waterwall tubes tends toward reduced internal corrosion. The coating distributes radiant heat over a greater surface and, in addition, permits lower burner tilt. This places the maximum heat release further down into the furnace, where it can be tolerated much easier than at the top.

04179

Z. Hertvik and O. Kralik

GAS REMOVAL FROM BITUMINOUS COAL PITS IN THE OSTRAVA-KARVINA DISTRICT. Czech. Heavy Ind. (Prague) 11, 34-6, 1966.

Degassing stations are used to remove gases from bituminous coal mines, especially in reducing methane exhalation by an average of 30 per cent. The reduced exhalation makes possible an improved venting of the pits, smaller air shafts, and thus reduced investment costs. The pits are also prepared for more rapid accessibility and for seam working. It becomes possible to use electric power on a wider scale and thus reduce the use of compressed air which is more expensive. The removal of mine gas is controlled and the possibility of its industrial utilization investigated. Absolute safety of operation of the degassing station is ensured by its perfect equipment with safety and control devices. (Author summary modified)

04200

F. E. Gartrell

CONTROL OF AIR POLLUTION FROM LARGE THERMAL POWER STATIONS. Rev. Soc. Roy. Belge Ingrs. Ind. (Brussels) (11) 471-82, Nov. 1966. (Presented at the Symposium on Air Pollution Control, Essen, Germany, Mar. 9, 1966 and at the Belgian Royal Society of Engineers and Industrialists Meeting, Brussels, Belgium, Mar. 16, 1966.)

Measures for the removal of particulates from stack gases and reductions in SO_2 emissions as well as the dispersion of emissions by high stacks and control by operational procedure are discussed. The results of air pollution monitoring near large power stations of the TVA are reviewed. Gas cleaning devices have been perfected so that 99.5% of the original ash content of the coal may be removed, although costs increase rapidly above 95%. In the future, removal of 99.5% of ash may be necessary in some plants based on combined mechanical and electrostatic collectors. There is a trend toward using electrostatic precipitators alone because of the high draft losses with mechanical collectors. While there are a number of promising developments in the removal of SO_2 from fossil fuels, the principal reliance for the next few years will have to be placed on dispersion from high stacks with possible supplementary operational controls. The height of TVA stacks varies from 150 to 800 ft, and tables are given of relationship between the maximum ground level SO_2 concentration, stack height, and wind speed. Data are also given of the frequency of occurrence of various ground levels of SO_2 in the area around the plants.

04506

I. A. Eldib

PROBLEMS IN AIR POLLUTION AND THEIR SOLUTIONS WITH NEW TECHNOLOGY (From: Technical and Social Problems of Air Pollution.) Symp. Metropolitan Engrs. Council on Air Resources, New York City, 1966. pp. 7-28.

The problems of sulfur dioxide and particulates in the atmosphere of New York City are discussed. Possible solutions to these problems lie in the elimination of vehicular emissions and the re moval of sulfur dioxide from flue gas. Among the methods proposed to reduce vehicular emissions are the redesigning of the automobile engine, the use of add-on exhaust control devices and four cycle diesel engines versus the addition of catalytic mufflers, and the possibility of employing fuel cells for vehicular propulsion are described. Removal of sulfur dioxide from flue gas is discussed through catalytic oxidation and the Reinluft process. The econo mic feasibility of sulfur dioxide removal from flue gas versus fuel oil desulfurization is studied, and costs aregiven. Nuclear power may be utilized to eliminate sulfur dioxide, but disposal of radioactive wastes presents a formidable problem.

04507

Harris, R. D. and R. G. Moses

STUDIES OF IMPROVED COAL DESULFURIZATION AT BITUMINOUS COAL RE- SEARCH, INC. (From: Technical and Social Problems of Air Pollution.) Symp. Metropolitan Engrs. Council on Air Re- sources, New York City, 1966. pp. 29-36.

Desulfurization studies are reviewed with the aim of overcoming some of the problems of washing pulverized coal in order to provide improved coal desulfurization at a cost per ton no higher than pre- sently incurred for washing the coarse product at the mine. Stu dies indicated that pulverization to 0.01 inch x 0 enhanced clean ability. It is felt that by optimizing the desulfurization of certain low cost coal cleaning systems, it should be possible to remove significant amounts of coarse pyrite from the feed prior to pulverization. Thus, a lower sulfur coal can be produced than by washing the coarse product. A program for developing improved coal desulfurization processes is described. Topics discussed include electrostatic and other separators, and pyrite removal. A flow diagram of the conceptual two stage pulverized coal cleaning system is provided.

04508

Lemon, L. W. CLEANER ATMOSPHERE BY BAG FILTRATION OF POWER PLANT STACK

EFFLUENT. (From: Technical and Social Problems of Air Pollution.) Symp. Metropolitan Engrs. Council on Air Resources, New York City, 1966. pp. 37-49.

The control of stack gas effluent from power plants by bag filtra- tion is discussed. The use of cloth filters was considered imprac tical because of the expected rapid rate of deterioration. However the introduction of new materials such as siliconized and finished fiberglass teflon or graphicil fiberglass fabric is expected to greatly reduce the expense of bag replacement. A brief description is given of the design and method of operation of the bag filter house in use at an experimental installation of the Southern Cali fornia Edison Company. Other test installations are also de scribed with encouraging results. Runs with normal gas at 270 F without additive have demonstrated 99.9% removal of particulate matter, nearly complete elimination of SO_3 and no visible plume. Research along other lines is mentioned and the work done by the Pennsylvania Electric Company on a system to remove most of the SO_2 from effluent gases of coal-fired boilers is cited.

04516

R. E. George and R. L. Chass

CONTROL OF CONTAMINANT EMISSION FROM FOSSIL FUEL-FIRED BOILERS. J. Air Pollution Control Assoc. 17, (6) 392-5, June 1967. (Presented at the 151st National Meeting, American Chemical Society, Symposium on Fossil Fuels and Environmental Pol- lution, Pittsburgh, Pa., Mar. 22-25, 1966.)

The topics covered include: air pollution from combustion sources control of combustion; a case study of Los Angeles County vs. New York City; and power plant control in Los Angeles County.

04634

T. P. Varshavskii, A. M. Denisov, L. E. Zlatin, and K. V. Zolotarev

SMOKELESS CHARGING OF COKE OVENS. Coke Chem. (USSR) (English Transl.) (6) 26-31, 1965. Russ. (Tr.)

A pilot-commercial smokeless charging plant has been built on No. 1 battery at the Kemerovo Coke and Chemical Works along the lines of those at VUKhIN and the Magnitogorsk Integrated Iron and Steel Works. A new smokeless oven charging system has been devised and introduced on the No. 1 battery at the Kemerovo Coke and Chemical Works based on separate consecutive emptying of the charging-car hoppers (4,3,2 and 1) with suction of the charging gases only into the coke side collecting main. The possibility of the saleable tar being contaminated with ash or heavy tar products has been eliminated. 4.0 tons/day of high-ash tar was obtained from the coke side collecting main. The nitric oxide content of the raw gas from No. 1 battery is 16.5 cc/cu meter. Accordingly it is vital to solve the problem of how to remove the nitric oxide from the charging gases or how to isolate and utilize them without purification. The satisfactory operating results of the plant enable this system to be recommended for works which do not supply gas to nitrogenous fertilizer undertakings. (Author conclusions)

04655

M. Atsukawa, Y. Nishimoto, K. Matsumoto

DRY PROCESS SO2 REMOVAL METHOD. Tech. Rev. Mitsubishi Heavy Ind. (Tokyo) 4, (1) 33-8, 1967.

The wet process for the removal of SO2 contained in exhaust gas emitted from thermal power plants has the drawback of lowering the gas temperature when the SO2 is removed. Therefore, recently, study has been given to use of the dry process of SO2 removal. A new dry process was developed using activated manganese oxide as an absorbent and capable of recovering ammonium sulfate as a by-product. The process has been named the DAP-Mn Process. Pilot plant tests have been made on the flue gas of an oil-burning thermal power plant and more than 90 percent SO2 was removed. The results of these tests are given and various problems for the practical application of the dry process are discussed. (Author abstract modified)

04755

R. E. Adams, J. S. Gill, W. D. Yuille, L. F. Parsly, C. E. Guthrie

FILTRATION OF PARTICULATE AEROSOLS UNDER REACTOR ACCIDENT CONDITIONS. Oak Ridge National Lab., Tenn. (Rept. No. ORNL-TM-1707.) Dec. 5, 1966. 35 pp.

The effect of accident environments on the performance of filter systems was studied on both a laboratory and a pilot plant scale. In the laboratory, the work included the development of a simple method for generating a simulant aerosol, tests of these aerosols to determine their validity as simulants, and measurements, under various atmospherees, of the efficiency of high-efficiency filter media for removing these simulant aerosols. Moisture was noted to have a significant effect on the behavior of the simulant aerosol. A limited number of tests were conducted at the Nuclear Safety Pilot Plant to demonstrate the operation of a larger-scale filter system in a simulated accident environment. (Author abstract modified)

04791

R. Germerdonk

SCRUBBING SULFUR DIOXIDE FROM FLUE GASES. Auswaschen von Schwefeldioxyd aus Rauchgasen. Chem. Ingr. Tech. 37, (11) 1136-9, Nov. 1965. Ger.

The expenditures for desulfurization of gases by a wet method are investigated. An oil-fired powerstation of which the sulfur dioxide content of smoke gases has to be lowered from 5 g/m3 to approximately 50 mg/m3, serves as a model. The wet scrubbing method discussed in this paper, although lower in costs entitles a quite complicated procedure. However, it has the advantage that by a reduction of 99% of the sulfur content, only an insignificant amount of residual matter develops.

04842

Harrington, R. E., R. H. Borgwardt, and A. E. Potter

REACTIVITY OF SELECTED LIMESTONES AND DOLOMITES WITH SULFUR DIOXIDE. Amer. Ind. Hyg. Assoc. J., 29(2):152-158, March-April 1968. 5 refs. (presented at the Annual Meeting, American Industrial Hygiene Conference, Chicago, Ill., May 1-5, 1967.)

Tests in a fixed-bed sorption unit were made to evaluate the reactivity of 10 naturally occurring limestones and dolomites with sulfur dioxide in flue gas. Reactivity of individual samples varied with calcination time, calcination temperature, and reaction temperature; the variations in reactivity among the different test materials, however, were greater and more significant. No correlation was found between differences in reactivity and chemical composition. Physical properties of the reactant materials appear to be important in sorbent reactivity. Although much additional research remains to be done work thus far indicates that utilizing limestone or dolomite for removal of SO2 from flue gas should be technically and economically feasible. (Authors' abstract)

04940

W. T. Sproull

FUNDAMENTALS OF ELECTRODE RAPPING IN INDUSTRIAL ELECTRICAL PRECIPITATORS. J. Air Pollution Control Assoc. 15, (2) 50-5, Feb. 1965.

The electrodes in industrial precipitators collect many tons of dust daily, and the efficient transfer of this dust burden to the hoppers is a challenging problem in mechanical engineering. Many varieties of devices have been tried; hammers, vibrators, scrapers, water flushing, gas blasting, etc. Impact devices for this purpose are usually called 'rappers.' Laboratory experiments described in this paper show that normal (perpendicular) rapping is more effective than shear rapping; that thick dust layers are more easily removed by rapping than thin ones; that rapping becomes easier with increasing temperature, within limits; and that the electrostatic forces acting upon the precipitated dust layer play an important role. Quantitative data are shown graphically. The relation of these results to previous studies by other investigators is discussed. (Author abstract)

05162

National Coal Association, Washington, D.C. (Dec. 1962). 18 pp.

LAYOUT AND APPLICATION OF OVERFIRE JETS FOR SMOKE CONTROL IN COAL-FIRED FURNACES .

The design, construction and application of overfire jet systems to prevent smoke from hand and stoker-fired furnaces is covered. Factors are presented for determining the size, spacing and disposition of the tubes for introducing overfire air into furnaces, as well as recommendations for construction of overfire systems to obtain maximum effectiveness. Overfire jets eliminate smoke by mixing air and unburned hydrocarbons under proper conditions of temperature and time for complete combustion. Although overfire jets are used primarily to eliminate smoke,their application often promotes increased combustion efficiency and better furnace performance. It has been demonstrated that certain advantages, in addition to smoke elimination, may be obtained where jets are installed. These are: (1) Reducing slag and soot accumulations on boiler tubes; (2) shortening the flame which, in turn, reduces stack temperatures, provided other combustion conditions are unchanged; (3) reducing excess air required to attain complete combustion; (4) reducing carbon in the cinder carryover; and (5) increasing the boiler's range of smoke-free operation by approximately 20 percent of the boiler capacity. Increases of 2 or 3 percent in boiler efficiency following the installation of jets are common. In most overfire jet applications air is injected into the furnace by means of nozzles to produce the proper mixture of oxygen and hydrocarbons and the required turbulence in the critical zones. Steam-air jets are used when no blower is available or when a low initial cost installation is desired. Steam jets should be used alone when the injection of additional air into the furnace would jeopardize performance.

05163

National Coal Association, Washington, D.C. (Sept. 1961.) 14 pp. (A.I.A. 34-C.)

MODERN DUST COLLECTION FOR COAL-FIRED INDUSTRIAL HEATING AND POWER PLANTS .

A general guide is presented to dust collection equipment for managements considering installation of a new plant or modernization of an existing plant. It describes currently available types of equipment and their application to the several methods of burning coal. Sections are included on inertial collectors, fabric filters, wet scrubbers, and electrostatic precipitators.

05198

N. E. Brennan

CONTROL OF SULPHUR DIOXIDE EMISSION FOR PROPOSED 400 MW GENERATING UNIT AT SEWARD GENERATING STATION, PENNSYLVANIA ELECTRIC COMPANY . Jackson & Moreland, Inc., Boston, Mass. Nov. 1961. 19 pp.

The purpose of this study was to determine the most satisfactory method of controlling the future ground level concentration of SO2 emitted from the chimney of a proposed 400 mw generating unit, located on the Conemaugh River at Seward, Pennsylvania. Three methods of control were investigated: (1) A 99.7% efficient precipitator and a 900 foot chimney was the basis for comparison, both as regards expense and SO2 ground level concentration. (2) Use of washed coal with a 99.3% efficient precipitator and a chimney 500 feet high. (3) Flue gas washing equipment, installed with a 99.7% efficient precipitator and a 500 foot chimney. Minimum chimey height for the coal washing and gas washing control methods was based on a reoccurring night-time stagnation layer, reported to be under 700 ft, which effectively seals the valley and prevents dispersal of SO2. A 500 foot chimney should be the safe minimum height, being able to jet the plume through the layer and out of the valley. Results of the study, indicated that neither coal washing nor gas washing equipment could be included in plans for a 400 mw unit. Coal washing is a technically possible, but very expensive method of controlling the ground level concentration of SO2, when compared to the cost of a tall stack and high efficiency precipitator. The objective was to produce similar ground level concentrations by balancing a high efficiency precipitator and a tall stack against a coal washing plant combined with a shorter stack and a less efficient precipitator. Because of topographical and meteorological considerations, the minimum stack height, based on SO2 concentrations, required with the coal washing plant had to be increased by about 100 feet to 500 feet, and to maintain the original purpose of the report the Base Plan chimney height had to be increased from 700 feet to 900 feet. The resulting reduced ground level concentration are presented. At the present time, progress in flue gas washing is such that it is not possible to recommend any proven process. The non-regenerative limestone process, which is similar to the Battersea process except that the effluent is treated, is considered in this report. At best, flue gas washing must be considered to be still in the experimental stage, and to date, attempts at flue gas washing have been largely unsuccessful.

05258

W. L. Sage

COMBUSTION TESTS ON A SPECIALLY PROCESSED LOW-ASH LOW-SULPHUR COAL (FINAL REPT. MAY-JULY 1964) Babcock & Wilcox Co., Alliance, Ohio. 1964. 31 pp. e8Rept. No. 4439.)

The purpose of these tests was to determine the burning characteristics of a fuel obtained by a solvent extraction of the combustible matter in coal. These determinations were to be based on laboratory analysis and on firing tests of this fuel in both the liquid and pulverized form. Laboratory tests were made to determine the chemical analysis of this fuel and the remaining ash, its viscosity-temperature relationship, comparative burning characteristic by use of thermogravimetric analysis (TGA) and its grindability. The test coal was fired in the atomized form employing a conventional type burner employed for No. 6 fuel oil (bunker C). Firing tests were also made in a small laboratory furnace using the fuel in the pulverized form. Based on results of both the proximate and ultimate analyses, this material appears very similar to a high volatile bituminous coal except for a reduction in sulphur and ash content. Ash analyses indicate a tendency for selective removal of the various constituents, i.e., ash was high in sodium and titanium compared to the normal range of coal ashes. Thermogravimetric analyses indicate ignition characteristics similar to a high volatile bituminous coal. However, for complete combustion or burnout this fuel appears to more closely resemble a semi-anthracite. The Hardgrove grindability index is 164, indicating this fuel could be pulverized with low power requirements. Firing tests in the atomized form indicate this material can be pumped and burned in the atomized form provided it is heated to adequate temperatures. For good pumpability (less than 1000 centipoises) the material must be heated above 500F, and for atomization (less than 30 centipoises) it must be heated above 635F. Firing tests in the pulverized form indicate this material has ignition characteristics similar to a high volatile bituminous coal. However, the carryover of unburned carbon more closely paralleled those obtained with low volatile bituminous or semi-anthracity coal. (Author abstract modified)

05310

Borgwardt, Robert H., Richard E. Harrington, and Paul W. Spaite

FILTRATION CHARACTERISTICS OF FLY ASH FROM A PULVERIZED COAL-FIRED POWER PLANT. J. Air Pollution Control Assoc., 18(6): 387-390, June 1968. 7 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper 67-35.)

The operating characteristics of a pilot baghouse and the filtering characteristics of fly ash filtered from the flue gas of a pulverized coal-fired power plant, were studied using techniques developed in the engineering research laboratories of the National Center for Air Pollution Control in Cincinnati. The permeability of the dust cake was found to vary with the operating conditions of the baghouse in a way which significantly affects the pressure drop and power requirements of the system. (Authors' abstract)

05338

A. M. Squires

TOP HEAT CYCLE FOR CLEAN POWER. Chem. Eng. Progr. 62 (10), 74-81 (Oct. 1966).

The top heat cycle for clean power, together with gasification and gas purification processes, appears to offer the prospect for generating electricity from sulfur-bearing fuel with no discharge of objectionable effluents, and at a cost saving relative to a conventional power plant. The top heat power cycle is significantly more efficient than the gas-steam combined cycle, and may furnish the incentive for development of the required gasification processes. The efficiency improvement comes about because much more heat can be absorbed by cycle fluids at temperatures close to the maximum set by turbine-blade metallurgy. The quantity of flue gas in the gas-steam combined cycle is limited by stoichiometry-there is no incentive to use excess air, as in an ordinary gas-turbine cycle-and this fact sets a limit on the amount of heat which can be absorbed at temperatures close to the maximum. Beyond the limited amount of heat disposable to the gas-turbine cycle fluid, excess high level combustion heat must be degraded across boiler surface to boiling water or steam. This limitation is removed in the top heat cycle since, for a given turbine temperature, the heat which can be added to steam by direct combustion of fuel and oxygen is limited only by steam pressure and the number of reheats provided. Yet the top heat cycle retains a substantial part of the Rankine steam cycle's outstanding advantage of rejecting heat at the lowest possible level. The top heat cycle appears to offer the prospect that plant can be provided to generate electricity from a sulfurous fuel such as Kuwait heavy residue with no discharge of objectionable effluents, and at a cost saving relative to conventional plant. It is too soon to state quantitatively the advantage of the cycle, but an interim guess would put the advantage at about 4 cents per MM Btu of fuel burned in first-generation plant, when fuel costs 30 cents per MM Btu. This for plant using low temperature oxygen and a fairly modest turbine temperature. There is at least a fair prospect that a sibnificantly greater advantage can derive from second and third-generation top heat plant using oxygen from an absorption-desorption process and a higher turbine temperature.

05454

H. Perry and J. A. DeCarlo

THE SEARCH FOR LOW SULFUR COAL. Mech. Eng. 89(4) 22-8, Apr. 1967.

Solutions to problems of sulfur oxides from coal such as: low-sulfur coal, sulfur reduction in coal, and removal of the sulfur oxides from the flue gas are available, but at a high cost. The largest reserves of low-sulfur coals are in the West in areas of low demand or held 'captive' by the steel industry which can pay premium prices. None of the methods for removing organic sulfur from coal such as solvent extraction, liquefaction, gasification, chemical, or bacterial treatments are low enough in cost to warrant commercial exploitation. Removing pyritic sulfur (40-80% of the total) involves fine crushing and separation at the point of use. Further research and development is needed before any of the separation methods such as magnetic separation, froth flotation, concentrating tables, or bacterial action could become commercial. The addition of limestone or dolomite during combustion offers promise of sulfur oxide reduction from 25-50% in existing plants. The costs of removal of the sulfur oxides from flue gas by high temperature methods such as the vanadium oxide oxidation process, the Reinluft process, and the alkalized alumina method are still quite high ($0.75 to $1.50 per ton of coal). This removal from the stack at high temperatures offers the most promising solution and new methods could reduce these costs.

05508

J. B. Kirkwood

ELECTROSTATIC PRECIPITATORS FOR THE COLLECTION OF FLY ASH FROM LARGE PULVERISED FUEL FIRED BOILERS. Proc. Clean Air Conf., Univ. New South Wales, 1962, Paper 14, Vol. 2, 20 p.

The performance of electrostatic precipitators is reviewed in the light of the experience of The Electricity Commission of New South Wales, and data derived from the analysis of pilot plant investigations carried out by manufacturers at Commission power stations. The factors affecting the usefulness of pilot tests are discussed and it is concluded that performance in a precipitator is largely independent of gas velocity in the normal operating range but varies markedly with changed of specific collecting area. Performance level achieved is low in comparison with experience in the United Kingdom and the United States. High dust resistivity and difficulty of rapping clean the collecting electrodes are major factors affecting performance. Migration velocity decreases significantly with increasing specific collecting area and the results obtained suggest that this effect is more marked than could be accounted for by changes in size distribution as the gas passes through the precipitator. It is suggested that the migration velocity of the finer fractions of dust decreases in successive stages of a precipitator due to the reduction in dust concentration and probably also to the removal of the coarse particles. Tests have indicated that combined mechanical collectors and electrostatic precipitators are less favourable than straight electrostatic units. Gas conditioning tests, particularly with SO3, have shown that this form of treatment has considerable promise. (Author abstract)

05516

N. Y. Kirov

EFFICIENT COMBUSTION-THE CONTROL OF AIR POLLUTION AT THE SOURCE. Proc. Clean Air Conf., Univ. New South Wales, 1962, Paper 22, Vol. 2, 22 p.

The basic combustion processes involved in the burning of carbonaceous fuels are outlined. The requirements for efficient combustion are then considered and the mechanism of formation and nature of smoke are discussed and illustrated by examples from industrial processes. An analysis of the factors affecting the efficient operation of fuel-using plant and special reference is made to the effects of smoke and associated losses from unburnt combustibles. It is emphasized that when smoke is made, it is accompanied by combustible gases which are the main source of heat losses, due to incomplete combustion. Finally, the occurrence and significance of sulphur in Australian fuels is examined in connection with the emission of acid smuts and sulphur oxides. The paper concludes with a brief discussion of methods which have been developed to alleviate the problems arising from the presence of sulphur in mineral fuels. (Author abstract)

05529

Cochran, N. P.

PROTECTING AIR RESOURCES OF TOMORROW'S CITIES MEETING POWER DEMANDS WITH COAL. Proc. Sanitary Eng. Conf., Air Resources Planning Eng., Pittsburgh, Pa., 1965, pp. 61-5.

The coal industry generates about two-thirds of the electric power used in the United States; this power generation represents an annual coal market of about 200-million-tons-plus and is growing; and the coal industry can determine to do whatever is necessary to maintain this market. To insure this market for the coal company of tomorrow so that the citizen of tomorrow can live in clear air in a society where electric power is taken for granted is the aim of the coal industry and its research people in the Office of Coal Research and other governmental agencies. Work that has been done to eliminate pollutants from the products of coal combustion have taken three historic courses: (1) Elimination or removal of the sulfur and other mineral matter prior to combustion; (2) Recovery of potential pollutants from stack gases; and (3) A combination of the foregoing. The most significant possibility for potentially reducing air contamination for tomorrow's cities from coal-fired power plants may lie in the areas of esoteric power generation schemes, i.e., a system for generating power using a coalefired fuel cell. Preliminary work that has been done to date indicates the possibility of a direct current power plant of the future burning coal in a fuel cell system costing about $130 per kilowatt (for large scale plants), with an over-all efficiency as high as 70 percent. Sulfur in the coal could be recovered as elemental sulfur following scrubbing and conversion. The sulfur so formed might be sold as a by-product or injected into deep ground strata for disposal. The generation of power using magnetohydrodynamics holds possibilities for recovery of not only the sulfur but the oxides of nitrogen present in high-temperature flue gas. Such a system might recover not only the sulfur but fix atmospheric nitrogen and produce desirable fertilizer by-products. This magnetohydrodynamic system is currently being studied by OCR and a detailed engineer ing evaluation of the system may be undertaken.

05531

Tailor, J. P.

THE STUDY OF THE CVX WET GAS SCRUBBER IN ITS APPLICATIONS ON POWER STATIONS, FOUNDRIES, AND IRON ORE MILLS. Preprint. (1967).

The Controlled Vortex principle of low pressure, high efficiency cleaning was applied to large volume conditions. In each case, the waste product must be recovered or disposed of so as not to create a secondary pollution problem. The total engineering concept is requested by every customer. THIS MEANS THAT IN EVERY APPLICATION THE GAS CLEANING DEVICE BECOMES ONLY A SMALL PART OF THE TOTAL POLLUTION CONTROL SOLUTION.

05853

C. R. Flodin and H. H. Haaland

SOME FACTORS AFFECTING FLY-ASH COLLECTOR PERFORMANCE ON LARGE PULVERIZED FUEL-FIRED BOILERS. Air Repair 5(1), 27-32 (May 1955). (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 28-Dec. 3, 1954.)

A broad view is taken of the term 'performance' of fly-ash collectors as referring not only to total solids collection or efficiency, but also to operation and maintenance aspects of performance. The relation of plant and boiler design to operation of collectors has also been considered. The following aspects of collector performance were covered: (1) SO3 is an effective conditioning agent to improve Cottrell electrical precipitator performance. The recent trend toward designing boilers for minimum contact of gases with interior surfaces may reduce the tendency of oxidation of SO2 to SO3 with adverse effects on precipitator performance; (2) Combination high-efficiency cyclonic collectors and Cottrell precipitators have both tangible and intangible advantages in the fine cleaning of pulverized-fuel-fired boiler gases; (3) The particle size of the fly ash from many boilers is about 35% minus 10 microns, which supports the applicability of high-efficiency cyclonic collectors; (4) The importance of good gas and dust distribution by the use of turning vanes, splitters, and perforated plate distribution facilities in the flues ahead of collectors cannot be overemphasized; (5) The trend toward low air-heater exit temperatures of 275 F. (or less) as opposed to the older practice of about 350 F. aggravates the condensation and corrosion, and the operating and maintenance problems in collectors; and (6) The design of the boiler plant, as well as the design of the collectors themselves, has a very direct bearing on collector performance. A check list of collector-design features for evaluation purposes is given.

05857

D. H. Barnhart and E. K. Diehl

CONTROL OF NITROGEN OXIDES IN BOILER FLUE GASES BY TWO-STAGE COMBUSTION. J. Air Pollution Control Assoc. 10 (5), 397-406 (Oct. 1960). (Presente at the 52nd Annual Meeting, Air Pollution Control Association, Los Angeles, Calif., June 21-26, 1959.)

Two-Stage Combustion with auxiliary-air ports above the burners is an effective method for controlling the nitric oxide concentration in boiler flue gases while still maintaining acceptable boiler performance. While utilizing this method of operation, with 95% of the combustion air through the burners, the nitric oxide level was reduced nearly 30% with both oil and gas firing. A reduction of 47% occurred during full-load oil firing when the air flow through the burners was 90%. The principal gains made in bringing nitric oxide under control are summarized. Two-Stage Combustion together with monor changes to the burner (approach-cone vanes out and air registers wide open) has given a total nitric oxide reduction of 56% when firing oil at full load. As mentioned previously, similar results can be expected in gas firing. It appears that additional reductions in nitric oxide would be possible if the air flow through the burners were reduced another 5 or 10%. The limit would be reached when combustibles (carbon, CO, etc.) were detected at the furnace outlet, or when the burners became unstable. The Southern California Edison Company put the Two-Stage Combustion Method into extended test operation at their El Segundo Steam Station. Although the fuel-air mixing process requires careful balance between rapid mixing for best combustion, and delayed mixing for nitric oxide reduction, the change has not required expensive equipment nor has it involved any extensive alterations to the boiler. This method of burning has also been incorporated in the design of two new boilers for Edison's Mandalay Station and two for their Huntington Beach Station. Two-Stage Combustion is believed to be a practical operating method for the control of nitric oxide emission from large gas or oil-fired boilers. (Author summary modified)

05868

H. J. White

EFFECT OF FLYASH CHARACTERISTICS ON COLLECTOR PERFORMANCE. Air Repair 5 (1), 37-50, 62 (May 1955). (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 28-Dec. 3, 1954.)

The primary objectives were to describe the important properties of fly ash; to indicate the dependence of these properties on such factors as coal burned and furnace design and operation; to show the intimate relationship between fly ash characteristics and collector performance; to bring out the principles and methods used in precipitator design and operation to overcome adverse characteristics of fly ash; and to indicate future trends and advances which may be expected in this field. Collector performance is greatly influenced by the diverse physical and chemical characteristics of fly ash encountered in practice. The ash characteristics are measurable, but for projected boilers (which form the large majority of collector installations) are not in most cases accurately predictable. This complicates collector design and in some cases necessitates extensive changes in collector equipment after construction in order to meet unusually adverse ash characteristics. In general, conservative design is indicated, since collectors are expected to perform satisfactorily for whatever type of ash may happen to occur.

06062

E.-M. Koschany

THE OPERATION OF ELECTROPRECIPITATORS WITH PULSE VOLTAGES. (Untersuchungen uber den Betrieb von Elektrofiltern mit Impulsspannungen.) Staub (English Translation(27(4):5-7 (Apr. 1967). Ger. (Tr.)

Electroprecipitators were investigated by means of impulse voltages of medium frequency. The results are compared with those obtained with direct-current voltage. A considerable increase in separation efficiency was found for a dust which, as regards electroprecipitation, lies in a favourable resistance range (about 10 to the 9th power ohm cm), and particularly for dust with highly insulating properties (about 10 to the 13th power ohm cm), when power was supplied to the electroprecipitator at an impulse voltage of specific direct voltage components and impulse parameters. (Author's summary, modified)

06136

H. E. Haley

SO2 REMOVAL PROCESS PROMISES CLEANER AIR. Elec. World 167, (20) 71-5, May 15, 1967.

Of the dry processes being developed today for the control of SO2 from boiler stack emissions, the dry limestone technique has the lowest capital cost. It can be incorporated into existing as well as new boilers which makes the method both unique and flexible. The SO2 reacts within the boiler converting gaseous SO2 into a form that can be handled as a solid waste. The powdered limestone is injected into the convection section of the boiler and is in contact with the stack gases at the critical temperature of 1000 to 1800 F for less than 3 sec. After passing through the critical temperature zone, the CaSO3, CaS, CaSO4, unconverted limestone, and ash are removed by the existing ash-removal facilities. Electrostatic precipitator efficiency does not suffer from the additional load. The operating costs for the removal of 2/3 of the sulfur from the stack gases are 0.27 mils per kwhr which is equivalent to 5 to 8% increase in power cost for pollution control. The operating costs for the competitive Reinluft, alkalized alumina, and Penelec process are 0.19, 0.21, and 0.14 mils/kwhr, respectively, for 100% SO2 removal. However, the capital outlay for the dry limestone process is $1.00/kw compared to $17.77/kw for the Reinluft, $10.64/kw for the alkalized alumina, and $21.25/kw for the Penelec. Technological problems have raised doubt as to the commercial value of the Reinluft process.

06278

D. Bienstock, J. H. Field, H. E. Benson

SULFUR DIOXIDE IN ATMOSPHERIC POLLUTION, AND METHODS OF CONTROL. (Proc. Symp. Atmospheric Chemistry of Chlorine and Sulfur Compounds, Cincinnati, Ohio,) 1957. (1959). pp. 54-62. (Geophysical Monograph No. 3.)

The average sulfur content of coals used in this country is about 1.9%. The sulfur content of fuel oils will vary greatly because of the difference in the various crude oils and to a lesser extent upon the methods of refining. From the combustion of fuel oil and coal, an estimated 18,000,000 tons of sulfur dioxide, equivalent to 9,000,000 tons of sulfur was released to the atmosphere in this country in 1955. The undersirability of sulfur dioxide in the atmsophere has been recognized because of its highly irritating effect on the respiratory system, its adverse effect on plant life in concentrations as low as 0.3 parts per million, and its attack on many metals, fabrics and building materials. However, after many years very little legislation has been enacted to set specific limits of emission of this material except in a few instances in the vicinity of smelters. Some of the important factors to be considered in dealing specifically with sulfur dioxide produced in the combustion of fuels are discussed briefly. These factors are the following: Recovery of by-products, general process considerations, reduction of sulfur content of coal before combustion, mechanical cleaning of coal, low-temperature carbonization, carbonization in the presence of various gases, complete gasification of coal, removal of sulfur dioxide after combustion, and studies using solid absorbents.

06297L

Bureau of Mines, Pittsburgh, Pa., Coal Research Center.
(1966). pp. BM/23-BM/40.

CHARACTERISTICS AND REMOVAL OF PYRITIC SULFUR FROM SELECTED AMERICAN COALS. (SECTION UV OF AIR POLLUTION RESEARCH PROGRESS REPORT FOR QUARTER ENDED DECEMBER 31, 1966.)

There are three interrelated phases to this project. Phase 1 deals with the analysis of coals for total and pyritic sulfur. Phase 2 deals with the washability of coals selected by Public Health Service, with regard to the effects of coal size and specific gravity of the washing medium on the separation of pyritic sulfur. Phase 3 involves studies of the coals examined for washability, and of a statistically significant number of coals analyzed in Phase 1, by means of optical scanning techniques, to determine the size and mode distribution of the pyritic sulfur. In phase 1, 19 selected samples were analyzed for pyritic and total sulfur, in 15 counties in 6 states. In phase 2, seven washability studies on midwest coals were completed. The samples generally contained large percentages of sulfur, but unfortunately predominately of the organic form, which is nonamenable to liberation by crushing. In phase 3, data are presented for five additional coals relating the reduction in pyritic sulfur by float-sink cleaning to pyrite size distribution and coal-pyrite particle association, as determined by visual microscopic analysis. Mean particle sizes of pyrite in minus 14-mesh samples of these coals ranged from 70 to 440 microns, and reductions in pyritic sulfur ranged from 30 to 63% of the original content. Plots of pyrite reduction versus pyrite particle size and relative freedom of pyrite from coal, for all coals studied to date, show good correlation between these parameters. The relation of pyrite reduction to particle size appears to be more linear and more significant.

06307

V. I. Uskov

TESTING OF AN ELECTROSTATIC FILTER. (In: Air Pollution in Mines - Theory, Hazards, and Control.) Akad. Nauk SSSR. p. 238-342, 1962. Translated from Russian. CFSTI: TT 66-51043

An experimental electrostatic filter, was installed at the 'Yuzhnaya' mine of the Berezovskii Mine Complex in the manway of the underground milling chamber at the 162 m level. The filter is designed for the purification of dusty air which is drawn from under the principal dust sources of crusher9 The ventilation frame from the crusher was connected to centrifugal fan. Conical diffuser connected to the fan by a rubber hose was installed in the lower part of the manway and suspended from a wooden shelf. The shelf was coated with a caly solution as a sealer. The upper portion of the manway contained, in addition to the electrostatic filter, high-voltage equipment from X-ray unit installed on a horizontal concrete platform and consisting of a KUSA-180 control panel and high-voltage transformer of the type D-110 with full-wave reactification by means of four KR-110 tubes. The electrostatic filter was separated from the lower part of the manway by concrete partition. The air purified by the filter was fed to the crosscut of the cage shaft of the 'Yuzhnyi' pit where it mixed with the jet of fresh air supplied to the eastern wing of the mine. The operating of the mine electrostatic filter was based on the principle of separate ionization. For the first time in the U.S.S.R., a stationary installation of an electrostatic filter was successfully employed in a mine for dust removal from air. The electric method of air purification is efficient, economical and can be used for the elimination of dust from the air of the principal ventilation flows entering the mine and in the underground milling chambers. An electric filter with separate ionization ensures the purification of air entering the mine to the extent required by sanitary standards.

06345

J. H. Field

SUMMARY OF VISIT TO EUROPE ON SO2-REMOVAL PROCESSES (TRIP REPORT). Bureau of Mines, Pittsburgh, Pa., Coal Research Center. (June 1963.) 51 pp.

A summary of the efforts of some of the European oil companies, research groups and the Central Electricity Generating Board of England (responsible for building and operating all power plants in Britain) in the field of SO2 removal processes and control is presented. The organizations visited are as follows: British Petroleum of Germany; Reinluft Company, Germany; Bergbau Forschungs Institute, Essen, Germany; BIMP Offices in the Hague; Royal Dutch Shell Laboratories, Amsterdam; Cherchar Research Laboratories for Coal, France; Central Electricity Generating Board, Bankside Station; Central Electricity Board Research Laboratories, Leatherhead; Simon-Carves Company, England; D.S.I.R. Research Laboratory, Warren Spring, England; British Petroleum Research Laboratories, Sunbury-on-Thames. In general all agreed: (1) that restrictions on SO2 emission are forthcoming in England and Germany; (2) that new processes, such as the Reinluft and the alkalized alumina, need to be developed; (3) that research in SO2 removal is increasing in Europe (organizations active in this field at present being Reinluft, Bergbauforschungs Institute, Esso (Holland), Royal Dutch Shell, the Central Electricity Generating Board and the D.S.I.R.); (4) that wet scrubbing processes (including the NH3 process) are not attractive; and (5) that desulfurization of heavy fuel oils is both technically difficult and very expensive (estimates ran as high as $5 to $6/ton of fuel for 60-70% removal of sulfur).

06490

R. F. Waters, and H. Kenworthy

EXTRACTION OF GERMANIUM AND GALLIUM FROM COAL FLY ASH AND PHOSPHORUS FURNACE FLUE DUST. Bureau of Mines, Rolla, Mo., Rolla Metallury Research Center (Apr. 1967). pp. (Rept. of Investigations No. 6940.)

Laboratory-scale selective volatilization methods developed by the Bureau of Mines to recover germanium and gallium concentrates from coal fly ash and phosphorus furnace flue dust are summarized. In the better experiments between 85 and 98% of the germanium was recovered as the lower oxide and as sulfides, and between 75 and 97% of the gallium was recovered as the lower oxide and as the trichloride. Grades of the condensates were inconsistent and varied between a few tenths of a percent and 8 percent, depending on the method use. In the primary extractions of germanium alone the degree of enrichment surpassed 100 to 1, and for gallium the best ratio was 30 to 1. Upgrading of condensates by vaporization retreatment and by leaching and precipitation is discussed. An appreciable degree of mechanical preconcentration by attrition scrubbing and elutriation was possible on two fly ash samples. (Author abstract)

06543

D. Bienstock,J. H. Field,and J. G. Myers

PROCESS DEVELOPMENT IN REMOVING SULFUR DIOXIDE FROM HOT FLUE GASES. (PART 3. PILOT PLANT STUDY OF THE ALKALIZED ALUMINA SYSTEM FOR SO2 REMOVAL.) Bureau of Mines, Pittsburgh, Pa., Coal Research Center 58 pp. (July 1967). RI 7021)

The use of alkalized alumina in removing sulfur dioxide from a coal combustion flue gas at 625 degrees F was investigated on a pilot plant scale. The absorber was 26 feet long and 1.6 inches ID. Counter-current gas-solids flow at gas velocities of 8 to 15 ft/sec in the presence and absence of baffles, as well as solids entrainment at gas velocities of 20 to 23 ft/sec with solids recycle, were employed. The spent absorbent was regenerated as a fixed bed with the reducing gases--reformed natural gas and hydrogen. Twenty cycles of absorption-regeneration were successfully completed using the alkalized alumina rolled into spherical granules 10 to 16 mesh. There was no loss in activity of absorbent toward SO2 with a modest attrition equivalent to 0.1 percent of the solids feed. Supporting studies were conducted on the effect of the sodium content in the absorbent, the composition of the reducing gas, thermal treatment to increase absorbent hardness, and removal of absorbed chlorine from the absorbent. A mathematical model was formulated to describe the removal of SO2 by alkalized alumina from fixed and falling beds. (Author abstract)

06636

Bureau of Mines, Washington, C.C.

AIR POLLUTION RESEARCH PROGRESS REPORT FOR THE QUARTER ENDED MARCH 31, 1968. In cooperation with the Public Health Health Service.) (Mar. 31, 1967) 87 pp.

This report covers progress on research in the folloring areas: Sulfur dioxide removal from flue gas; Removal of sulfur oxides from flue gas with manganese oxide and improved regeneration; Economic evaluation of processes for the removal of sulfur dioxide from flue gas; Characteristics and removal of pyritic sulfur from selected American coals; Pollution by chlorine in coal combustion; Flame characteristics causing air pollution; Characteristics and photochemical reactivity of vehicular emissions; Mechanisms of air pollution reactions; Effects of engine, fuel and combustion system parameters on vehicular emissions; Composition, smoke and odor of diesel exhausts.

06697

REPORT ON SULFUR DIOXIDE AND FLY ASH EMISSIONS FROM ELECTRIC UTILITY BOILERS. Public Service Electric and Gas Co., Trenton, N.J.; Jersey Central Power & Light Co./New Jersey Power & Light Co., Morristown; and Atlantic City Electric b8co., N.J. (Feb. 24, 1967). 67 pp.

Progress to date and attainable goals in reducing sulfur dioxide and fly ash emissions from utility companies in New Jersey were discussed. This information will be utilized in formulating state policies with respect to these pollutants. The following topics are discussed: Sources of pollution; Status of abatement efforts; Proposed regulatory limits on sulfur in fuels; Reductions to be effected by 1968; Studies to effect additional reductions in near future; Long term solution; and Forecast sulfur dioxide and Forecast fly ash emissions.

06835

STUDIES ON SMOKE PURIFICATION. (Studio sui depuratori di fumo.) Fumi Polveri (Milan) 6 (3), 69-85 Mar. 1966. It. (Tr.) (Translated as JPRS-R-8463-D.) (Also published in Ind. Thermiques Aerauliques, (2) Feb. 1965.)

The purpose was to determine testing conditions for chimney-mounted smoke purifiers. The ultimate aim was to devise a method for controlling the efficiency of such devices. Five devices were tested, none of which had forced draft, mechanical acceleration of the velocity of the combustion gases, or water scrubbing. The effect of various wind speeds on the velocities and the pressure drop in the devices was measured in an experimental tunnel. The capture efficiency of the devices was tested using cold balsa and silica dusts to simulate soot agglomerates. The efficiency was further tested on a restaurant kitchen coal furnace, a screw-shaped coal burner in a cast-iron boiler, a coal stove and a liquid fuel burner mounted on the boiler. Stack samples were examined by optical and electron microscopy and the deposits' acidity was determined. Some test methods are proposed.

06999L

G. Spengler G. Michalczyk

SULFUR OXIDES IN SMOKE GASES AND IN THE ATMOSPHERE - A PROBLEM OF KEEPING THE AIR CLEAN. (Die Schwefeloxyde in Rauchgasen und in der Atmosphere - Ein Problem der Luftreinhaltung.) VDI (Ver. Deut. Ingr.) Ber. (Duesseldorf,) (Translated as JPRS R-8462-D.) (1964). 152 pp. Ger. (Tr.)

Since there are no methods that will, in each and every case of emissions of sulfur oxides into the atmosphere, reliably prevent such emissions and at the same time operate with some degree of economy and efficiency, a compilation of the literature available on this problem was arranged from a critical view point. The information is taken from generally available literature, private communications and reports by domestic and foreign agencies in government and industry. The following subjects are discussed: The sulfur content of fuels; the formation of SO2, SO3, and sulfuric acid; a general review of the physiological influences of SO2 on man, animal, and plants; the corrosion behavior of sulfur oxides; analytical methods for the determination of sulfur oxides; and legal measures for keeping air clean in West Germany, Great Britain, Russia, and the United States. Methods for the removal of SO2 from smoke gases by absorption, adsorption, catalytic oxidation, reduction, desulfurization of fuels, and control equipment are discussed extensively. Some economic and industrial problems connected with the removal of SO2 and a bibliography of 360 documents and communications are included.

07075

Gosselin, A. E., Jr. and L. W. Lemon

BAG FILTERHOUSE PILOT INSTALLATION ON A COAL-FIRED BOILER-PRELIMINARY REPORT AND OBJECTIVES. Proc. Am. Power Conf., Vol. 28, p. 534-545, 1966. 3 refs.

A pilot filterhouse was installed in July 1965 at the Mercer Generating Station of Public Service Electric and Gas Company. The objectives of the research program are reviewed and preliminary test observations and experiences of the pilot bag filter house operation are reported. A general discussion of the power industry and air pollution, general program procedure, steam generator effluent investigations, experimental facility and test program, test observations and experiences, and program status is included. Preliminary performance of the pilot filterhouse demonstrated that full scale application may be economically feasible. A detailed continuous demonstration program is currently in operation at the Mercer pilot filterhouse over a filter ratio range of 4.5 to 5.0:1, in an attempt to develop conclusive, practical performance of a commercial application.

07229

Hertel, W.

FLUE GAS AND ASH DISPOSAL AND MAIN STRUCTURE OF A POWER STATION. Rauchgas-und Aschenabfuhrung sowie Haupttragkonstruktion eines Blockkraftwerks. Brennstoff-Warme-Kraft (Duesseldorf) 19 (5), 245-9 (May 1967) (Ger.)

A design for the building of a 300-mw power station is presented. A steel chimney placed on top of the building with the vertical boiler is incorporated for economy. Adjacent is the generator house on top of which electrofilters, ventilators, and air pre heaters are located. The structural analysis as well as a cost estimate os the steel framework is outlined. According to where the ash mills are located, ash is discharged either directly under the boiler or in a basement underneath the boiler house.

07359

Debrun, G.

THE CONTINUOUS MEASUREMENT OF THE DUST CONTENT OF THE COMBUSTION GASES, AT THE EXIT OF THE DUST COLLECTORS IN THE LARGE CENTRAL POWER STATIONS OF ELECTRICITE DE FRANCE. ((La Mesure en Continu de l'Empoussierement des Gaz de Combustion a la Sortie des Depoussiereurs des Grandes Centrales Thermiques E.D.F.)) Text in French. Pollut. Atmos. (Paris), 9(34):84-90, Apr.-June 1967. 2 refs.

The production department of the Electricite de France in an effort to improve the monitoring of their dust collectors has conducted an investigation of the various types of continuous recording instruments to measure the fly ash passing the dust collectors. The survey showed that the opacimeters are superior to the other devices considered, especially those which measure the dust content of only a small volume of the total gas stream. The opacimeter or transmissometer measures the fluctuations in the light intensity at a photoelectric cell from a standard light source across the gas stream which result from the variations in fly ash content of the gas stream. The optical system is balanced with one beam passing through the gas stream and one beam which does not, which eliminates problems from fluctuations in the intensity of the light source. The device should be accurate within 10%, with the main sources of error: the fouling of equipment; misalignment of the light beams; and deterioration of the system. Opacimeters (transmissometers) are the instruments of choice for continuous monitoring of leakage from dust collectors.

07385

D. T. King

DUST COLLECTION IN COAL PREPARATION PLANTS. Mining Engr., 19(8):64-69, Aug. 1967.

Particulate collectors which operate by gravity, inertia, centrifugal force, impingement, and electrostatic fields are reviewed. The chief types of dust collectors such as cyclones, electrostatic precipitators, fabric filters, multiple cyclone collectors, wet impingement scrubbers, irrigated centrifugal scrubbers, centrifugal spray chamber collectors, self-induced spray collectors, wet dynamic precipitators, venturi scrubbers, and disintegrator scrubbers are illustrated, by schematic drawings. The economics for the collection of dust in the cola industry are evaluated. Some seams give a premium quality coal dust with lower ash and sulfur content than the larger size product. The saleable value of such a dust may justify its recovery in addition to the justifications provided by air and stream pollution regulations, community good will, potential damage to plant equipment, better employee relations, and control of safety hazards.

07416

DUST CONTROL METHODS. Coal Age,72(8):56-62, Aug. 1967.

The control of dust, soot, smoke, and fumes that accompany coal preparation operations has become an important part of the successful plant as public conern about air pollution increases. In addition to a discussion of the various types of dust collecting and cleaning systems, the characteristics and applications of these systems are compared in a chart. Selection of equipment best suited to handle a specific dust control problem is thus simplified.

07417

Field, J. H., R. C. Kurtzrock, and D. H. McCrea

HOW TO PREVENT SO2 EMISSION. Chem. Eng., 74(13):158-160, June 19, 1967.

A new absorption process for the removal of sulfur dioxide from flue gases has been developed. The process consists of contacting the flue gases against an 'alkalized alumina' absorbent that reacts with SO2, thus removing it from the gas stream going to atmosphere. The absorbent medium is a coprecipiate of sodium and aluminum oxides. Ab2orption involves the oxidation of SO2 and its subsequent reaction with the metal oxide to form the sulfate. The spent absorbent is regenerated by contacting it with a reducing gas. Held on the absorbent as the sulfate , sulfur is reduced to H2S and carried off as part of the regenerator effluent. The latter is then processed for recovery of elemental sulfur. The absorber is designed for 90% removal of total sulfur in flue gas. This alkalized alumina process removes SO2 without reducing the flue gas temperature therefore increases heat-recovery efficiency. The absorbent contacting method for the removal of sulfur dioxide from flue gases has a low pressure drop and is flexible in its range of gas velocities, absorbent particle size and utilization. Its operating costs are also low because the process makes a valuable byproduct, elemental sulfur.

07425

J. W. Leonard, C. T. Holland, E. U. Syed

A SURVEY OF UNUSUAL METHODS FOR REMOVING SULFUR FROM COAL. Coal Age, 72(7):90-93, July 1967. 22 refs. (Presented at the Spring Meeting, West Virginia Coal Mining Institute, Morgantown, W. Va., Apr. 21-22, 1968.)

Electrical, thermal, and chemical methods for the removal of sulfur from coal are evaluated. These methods require a fine coal feed similar to that required in coal-burning power plants. The prospects of applying electrical, thermal or chemical beneficiation techniques to reduce sulfur in steam coal become less formidable with the knowledge that many coals when pulverized tend to concentrate very high percentages of pyrite in the larger sizes which commonly represent less than half of the coal. The chemical processes, unlike the thermal and electrical methods, possess inherent disadvantages in that the fine, desulfurized coal must be dried, and processing facilities must be large because of long retention times and bulk of materials. Thermal and electrical methods permit a continuous operation confined to relatively limited space requirements, and the product coal is dry. Unlike conventional methods they do not appear to have universal application to all coals.

07430

W. A. Pollock, J. P. Tomany, G. G. Frieling

FLUE-GAS SCRUBBER. Mech. Eng., 89(8):21-25, Aug. 1968.

The Turbulent Contact Absorber (TAC), utilizes turbulent motion of mobile packing to maintain high mass-transfer rates and efficient particulate collection over a wide range of flows with low pressure drop in the presence of a dense low pH slurry. This wet scrubber was tested for sulfur dioxide removal without sulfur recovery. Limestone injection directly into a coal-burning furnace to reduce SO2 emission was evaluated separately. From the data developed on the two systems it appears probable that limestone injection together with wet scrubber would result in effective simultaneous removal fo fly ash and sulfur dioxide. Flyash collection efficiencies in the order of 98% and SO2 removal of 91% can be expected at wet scrubber pressure drops of about 4.5 in. wg.

07466

Potter, A. E., R. E. Harrington, and P. W. Spaite

LIMESTONE-DOLOMITE PROCESSES FOR FLUE GAS DESULFURIZATION. Air Eng., 10(4):22-27, April 1968. 17 refs. (Presented at the American Chemical Society, Chicago, Ill., Sept. 11, 1968.)

Limestone-dolomite processes offer excellent potential for the control of sulfur oxide emissions from power plants operating on fossil fuels. In addition to summarizing present capabilities, current development work on three such processes is reviewed. current development work on three such processes is reviewed. Although calcination, mass transfer, and chemical reaction are important to desulfurization efficiency, no one factor is clearly rate-limiting. Engineering considerations such as sorbent dispersion, tube fouling, corrosion control, and waste disposal are very important in practical applications. Additional data from current and proposed studies are needed to establish capabilities and economics of the several processes. Among the methods being evaluated for desulfurization, the limestone-dolomite processes present distinct advantages for sulfur oxide pollution control. (Authors' abstract, modified)

07515

Sommerlad, Robert E.

FABRIC FILTRATION - 'STATE OF THE ART'. Preprint, Foster Wheeler Corp., Livingston, N.J., ((19))p., March 6, 1967. 15 refs. (Presented at the Air Pollution - Electric Generation Seminar, The Graduate School, Dept. of Agriculture in cooperation with the Public Health Service, Washington, D. C.)

The state of the art of fabric filtration as applied to power plant effluents is presented. Operating principles and cleaning techniques are discussed along with materials and some design parameters. Also covered is the past and present work done on the effective control of visible emissions due to fly ash and sulfur trioxide. A survey of the development potential of the baghouse filter for sulfur dioxide removal is presented. Listings of installations and estimated capital costs are also presented. (Author's summary, modified)

07673

Ungoed, W. P. C. and W. J. Needham

WASTE HEAT BOILERS FOR OPEN-HEARTH FURNACES. In: Fume Arrest- ment, Special Rept. 83, London, William Lea and Co., Ltd., 1964, p. 54-60. (Report of the Proceedings of the Autumn Gen- eral Meeting, Iron and Steel Inst., London, England, Nov. 26-27, 1963.)

The application of waste heat boilers as gas coolers is discussed and the smoke-tube and water-tube types of boilers are compared. The boiler design features, heat transfer, tube formation, and streaming pressures and methods of draught control are described. Boiler cleaning methods, shot cleaning for 'on-load' duties, and the statutory requirements on maintenance are discussed. The economy of the waste heat boiler is considered; waste heat steam credits, power generation, and capital returns on specific 'back pressure' type units are illustrated with figures for equipment currently in operation.

07674

Petroll, Joachim, Volker Quitter, Gunter Schade, and Loth- ar Zimmermann

TESTING CYCLONE SEPARATORS. Staub (English translation), 27(3):1-10, March 1967. 12 refs. CFSTI: TT 67-51498/3

Barth's cyclone theory was checked experimentally. The tests were carried out in the research division of the VEB PKM Kohleverarbeitung, Leipzig. The test dust was soft-coal dust from the cooling-tower collector of a briquette factory, separated in banked cyclones. Cyclone separators of different dimensions and made by different firms were tested under identical conditions. The test results are compared with the results obtained by the calculation method for cyclone separators according to Barth. It has been found that the Barth theory still does not describe, quantitatively and qualitatively, the actual conditions in a satisfactory way. (Authors' summary, modified)

07752

Kopita, R. and T. G. Gleason

WET SCRUBBING OF BOILER FLUE GAS. Chem. Eng. Progr., 64(1):74-78, Jan. 1968. 5 refs. (Presented at the 62nd National Meeting, American Institute of Chemcial Engineers, Salt Lake City, Utah, May 21-24, 1967.)

A wet scrubbing system that can be designed to remove 99 plus percent of the fly ash from the pulverized coal and stoker fired boilers is described. The same type of system can be utilized to remove 70 to 99.5 percent of the sulphur dioxide in the flue gas depending on the amount and type of absorbing liquid used. The cost of such a system is such that an early pay-out could result as compared to the extra cost of low sulphur fuel. The text and tables illustrate the effeciciencies that may be expected with respect to both SO2 and particulate matter removal, suitable materials of construction and various flow cycles including low-level heat recovery.

07931

Ertl, D. W.

ELECTROSTATIC GAS CLEANING. S. African Mech. Engr. (Johannesburg), 16(8):159-168, March 1967.

Electrostatic precipitators are a highly developed and efficient means of cleaning industrial and waste gases, satisfying all modern hygienic and industrial requirements. Each precipitator has to fulfill two functions: (1) electrically charging the dust and capturing it by electrodes which are at earth potential; and (2) passing this precipitated dust, with minimum re-entrainment losses, into the hoppers underneath the precipitation field. Parameters influencing the total dust collecting efficiency are: the ratio of the collecting plate area to gas flow rate, which is a dimension of the precipitator size; the migration velocity or the velocity by which the dust is attracted to the collecting plate under electrical forces, which is dependent on field intensity; the dielectric constant of the dust; the dew-point of the gas/dust mixture, high dew-point being better suited for precipitation than a completely dry gas. Factors adversely affecting precipitation efficiency are space charges, which develop when there are large amounts of very fine dust in the gas, and dust resistivity, which makes precipitation difficult when the dust layers have an electrical resistance of greater than approx. 10 to the 11th power ohm/cm. Precipitators are important for thermal power stations where the dust fineness must also be taken into account in design. The use of precipitators for blast furnaces and steel works, cement works, and in the chemical industry, is noted. Dust collecting efficiencies of 99.5% are not exceptional and greater efficiency is advisable in continuous operation at numerous plants. For optimum dust collecting results, the specific dust properties have to be taken into account during the planning stage of the whole plant.

07962

Belyea, A. R.

MANGANESE ADDITIVE REDUCES SO3. Power, 110(11):80-81, November, 1966.

A manganese-containing organometallic compound is now being used in several stations of Consolidated Edison Company as an additive in residual fuel oil that has a relatively high content of sulfur and vanadium. Tests have shown that the concentration of sulfur trioxide in the flue gases can be reduced by about 45% at a material cost of less than 0.7 cents per gal of fuel oil, equivalent to about 0.45 cents per million Btu. The test program also demonstrated that a reduction of SO3 from 25 ppm to 14 ppm lowered the dew point of the flue gases 12 F. Furthermore, the SO3 reduction affects the appearance of the plume, which is less opaque; burners have a clearer flame and exhibit less plugging, resulting in a cleaner boiler.

08080

Kukin, I.

UTILIZATION OF ADDITIVES IN CONTROLLED COMBUSTION PRODUCTS. Preprint, Apollo Chemical Corp., Clifton, N. J., 11 p., 1966. (Presented at the MECAR Technical Symposium on Combustion and Air Pollution Control, Oct. 25, 1966.)

Practical applications of chemical additives for reducing air pollution with petroleum fuels are discussed. Successful results have been achieved in the field by the use of additives for fuel oils, both distillate and residual fuels. The major pollutants are: (1) black particulate matter representing primarily unburned hydrocarbons, (2) sulfur oxides (SO2 and SO3). With distillate fuels, where the sulfur content generally is below 0.5%, our primary concern is particulate matter and to a somewhat lesser degree, carbon monoxide, aldehydes and nitrogen oxides. With residual fuels, sulfur, as SO2 and SO3, is the dominant consideration, although the ability to reduce black smoke emission by means of chemical additive is certainly a valuable contribution to air pollution control. The three effective classes of chemical additives are: (1) combustion catalysts, (2) oil-ash slag modifiers, and (3) chemical neutralizing agents. In some cases, these chemical agents can be combined to give one or more benefits. In a recent trial at a power plant, one of our products, SSI-3(R), reduced the black smoke at the same time that it lowered the SO3 content of the flue gas from 90 to 5 parts per million. The case histories cited show how chemical additives are being used to reduce air pollution at the same time that they make their contribution to better overall fuel utilization. AAM

08085

Mullen, J. F.

A METHOD FOR DETERMINING COMBUSTIBLE LOSS, DUST EMISSION, AND RECIRCULATED REFUSE FOR A SOLID FUEL BURNING SYSTEM. Preprint, Combustion Engineering, Inc., Windsor, Conn., Research and Product Development, 13 p., ((1966?)).

A method is presented which establishes a means of determining: 1. Solid combustible losses for solid fuel burning units. 2. Stack dust emission rates. 3. Recirculated system loadings. The paper is based entirely on three axioms. 1. All 0ash0, as determined from the 0proximate0 or 0ultimate0 analysis of fuel, fed to a furnace must be accounted for. 2. The 0ash0 entering a component, or system of components, per unit time, must be equal to the 0ash0 leaving the same component, or system of components in the same unit of time. 3. All 0ash0 has combustible matter associated with it to some degree. Solid-combustible-loss determination has always been an industry problem. The proposed method does not prevent one manufacturer (by means of total or partial reinjection of cinders) from quoting a lower carbon loss than another manufacturer, but it does enable one to calculate the effect of a specific determination on the recirculated flyash loading and the stack dust loading that will result when total or partial reinjection is employed.

08146

Uzhov, V. N.

SANITARY-TECHNOLOGICAL EVALUATION OF ASH-CATCHING SYSTEMS USED IN U.S.S.R. ELECTRIC HEAT AND POWER PLANTS. In: Survey of U.S.S.R. Literature on b8air Pollution and Related Occupational Diseases. Translated from Russian by B. S. Levine. National Bureau of Standards, Washington, D. C., Inst. for Applied Tech., Vol. 3, p. 87-92, May 1960. 1 ref. CFSTI: TT 60-21475

Two systems of ash-catching are presently in use in the U.S.S.R. electric heat and power plants which are burning hard fuel: 1) dry methods with the aid of battery cyclones and electrostatic precipitators, and 2) wet processes using centrifugal VTI Scrubbers or MP-VTI wet rod type ash-abators. In the past electric power plants predominently employed the dry type of ash-catching equipment; at present the trend has been reversed and the wet types of ash-catching installations have been favored predominently. The two ash-catching systems were evaluated and to make a rational choice between the two the efficiency of wet system ash-catching equipment did not exceed 90%. Ash collected by the wet systems presents serious hauling away problems and makes utilization of the collected ash for commercial purposes difficult, if not impossible. The ash thus collected must be disposed of at ash dumps, which in themselves become sources of air dust pollution. Wet methods of electro-station smoke gas purification can be used in small electro-stations, especially those located away from inhabited localities. The installation of wet type ash-collectors may be sanctioned in old electro-stations in which for reasons of space scarcity the installation of electrofilters may present major difficulties. Electro-stations of any considerable size which are surrounded by inhabited foci must be equipped with dry system ash-collectors, consisting of combinations of two-stage ash-collectors: battery cyclones plus vertical electrofilters of the DVP type, or of two or tripolar horizontal electrofilters of the DGP type capable of insuring smoke gas purification of not less than 95%.

08155

Matsak, V. G.

THE UTILIZATION OF AIR DUST AND SMOKE PURIFICATION EQUIPMENT. In: Survey of U. S. S. R. Literature on Air Pollution and Related Occupational Diseases. Translated from Russian by B. S. Levine. National Bureau of Standards, Washington, D. C., Inst. for Applied Tech., Vol. 3, p. 141-149, May 1960 CFSTI: TT 60-21475

In purifying air and gases from dust, the following factos must be taken into account: a)the weight of dust, which may vary from a few milligrams to tens of grams per cu m of air or gas; b) the size of dust particles and their weight/number ratios; c) the chemical composition of the dust and its susceptibility to wetting by water, oil and similar fluids. Existing means of purifying air from dust and smoke can be divided into dry and wet methods. Settling chambers, inertia dust separators, porous filters, electrostatic precipitators, water spray washing, and oil filters are discussed.

08228

Reed, Sherman K.

PROJECT COED (CHAR, OIL, ENERGY DEVELOPMENT). Preprint, FMC Corp., 4p., 1966. (Presented at National Coal Association Technical-Sales Conference and Bituminous Coal Research, Inc., Annual Meeting, Pittsburgh, Pa., Sept. 14-15, 1966).

The Char Oil Energy Development (COED) converts coal economically to synthetic crude oil, fuel gas, and a solid char fuel. Coal from a mine is crushed to less than 1/8-inch in size, and fed continuously to a multistage pyrolyzer. In the multistage pyrolyzer, the coal is fed from one pyrolysis stage to several others in sequence, each at a successively higher temperature. Volatile materials from the multistage pyrolyzer pass to a product- recovery section where oil and liquor are condensed from the gases. The gases then can be converted either to a high-Btu gas for pipeline use or to hydrogen for an ammonia plant or an oil refinery. The oil passes to a hydrotreating plant where it is reacted with hydrogen to produce a synthetic crude oil for sale to a petrolem refinery. The solid residue, char, from the multistage pyrolyzer is a fuel suitable for powerhouse use.

08342

Teller, Aaron J.

RECOVERY OF SULFUR OXIDES FROM STACK GASES. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 1-11, Oct. 23, 1967.

The criteria for the selection of an SO2 recovery process, exclusive of the traditional boundaries of economics, are: (1) stability of the chemical or physical recovery system to the submicron particulates and sulfur trioxide, (2) stability of the adsorption or catalytic material, (3) turndown capability of the system and (4) land area required by the recovery system. The systems under consideration based on a comparison of these characteristics in addition to the omnipresent economics were discussed. In spite of the superiority of the regenerative process, non-regenerative processes are important where emergency conditions exist or where the lack of available land area prohibits the installation of a regenerative recovery process. Effective recovery of SO2 in a non-regenerative form can be achieved with lime scrubbing. A second non-regenerative recovery method is the dry reaction of sulfur dioxide, oxygen and lime temperatures in the 1500 deg to 2000 deg F range. The regenerative processes offer the greatest potential for economic recovery and a preservation of the natural resource of sulfur. Among the processes under active consideration are: (1) alkalized alumina adsorption, (2) direct catalytic conversion to sulfuric acid, (3) char adsorption, (4) absorption accompanied by chemical reaction and (5) reversible chromatographic separation.

08346

Slack, A. V.

REMOVAL OF SULFUR OXIDES FROM POWER PLANT STACK GASES: OUTLINE OF MAJOR PROBLEMS. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 42-49, Oct. 23, 1967. 2 refs.

The several unresolved problems in reducing sulfur dioxide emissions from power plants make the status of both removal and recovery methods uncertain. Some of the problems do not have any obvious solution: the large tonnage of product made, both in regard to space for discarding of waste products and the economics of marketing very large quantities of any salable material made; declining load factor and variable operation of power plants, with adverse effect on operation of a chemical recovery plant; and growing use of nuclear power for new plants. For some processes, new fossil fuel plants are more amenable to fitting with sulfur dioxide recovery equipment than are old ones. The several other problems, mainly having to do with process operation, are less difficult in some respects and progress is being made in solving them.

08347

Haynes, W. P.

CURRENT WORK AT THE BUREAU OF MINES ON RECOVERY OF SULFUR OXIDES FROM STACK GAS. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 50-61, Oct. 23, 1967.

The Bureau of Mines is concerned with achieving the most effective utilization of the nation's natural resources. Economical recovery of valuable sulfur products from the combustion of fossil fuels supports both the goal of conservation and utilization of natural resources, and the national goal of abating air pollution. The Bureau's broad approach to the total problem may be divided into two: removal of sulfur from the coal before combustion and removal of the sulfur oxides from the products of combustion. Removal of sulfur from fuel oil is technically feasible and generally adequate when a hydrogen treatment process is used. The second basic approach--the processing of combustion furnace atmosphere and stack gases--offers the advantage of being versatile, applicable to the burning of both coal and residual fuel oil. Milestone projects led to further expansion of the Bureau program of developing methods of sulfur oxide removal from stack gas. The current basic program is outlined and discussed. It inclues benchscale studies, improvement of manganese oxide absorption and regeneration, exploration of solid absorbents for elevated temperature absorption, and evaluation of solid absorbents for the Teller chromatographic process.

08348

Cahill, William J., Jr.

CONTROL OF PARTICULATE EMISSIONS ON ELECTRIC UTILITIES BOILERS. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 74-84, Oct. 23, 1967.

Particulate control equipment utilized by Consolidated Edison in New York City from 1915 to the present is discussed. Present collectors were designed to collect fly ash from coals containing approximately 2% sulphur. However, the new air pollution law in New York City requires 99% collection efficiency on all coal burning equipment by 1969 and requires that all coals burned by 1971 shall contain not more than 1% sulphur. On boilers burning the 1% sulphur coal required by law, the 99% efficiency precipitator would be only about 98% effective because of the higher resistivity ash. To comply with this law, Consolidated Edison was confronted with three possible alternatives: (1) Add collecting surface and electrical sets to existing 99% collectors to maintain the necessary efficiencies when burning low sulphur coals; (2) add new precipitators in series with the existing precipitators to increase the efficiency from 97% to 99% and still be able to burn low sulphur coal; or (3) burn another fuel such as low sulphur oil or natural gas.

08352

Rowson, H. M.

DESIGN CONSIDERATIONS IN SOLVENT RECOVERY. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 110-128, Oct. 23, 1967.

The growing understanding of the adsorption process has led to the ability to modify the properties, such as pore size distribution and overall activity of the adsorbent, to suit the particular separation that is required. This has been accompanied by much development in the last few years of the fixed bed and fluid bed mechanical contacting that is available to carry out these separations, and as a result of these parallel developments, it is now possible to carry out with very great efficiency a large number of complicated separations. The fixed bed plant consists of a number of vessels containing activated carbon into which the solvent laden gas stream is introduced in turn. The solvent laden stream is allowed to flow through the carbon bed, the solvent is adsorbed onto the activated carbon, and the solvent free air is discharged into the atmosphere. In the fluidized bed process, the solvent laden air or gas stream is passed upwards through the adsorber vessel which contains a number of shallow fluidized beds of activated carbon. The solvent is progressively adsorbed onto the carbon, and the solvent free air is discharged through dust collectors to the atmosphere. This process has a number of advantages compared with the fixed bed process: 1. Exceptional contacting between solvent and adsorbent giving very high efficiencies; 2. Complete continuous automatic operation, with minimum labor requirements; 3. Competitive in cost for the medium and larger installation; 4. Low stripping steam usage (about half that of equivalent fixed bed plants). 5. Low ground area requirement; 6. High concentration of solvent in recovered agueous liquor simplifying onward processing; 7. Inherently safe even with highly inflammable solvents. Factors affecting the choice of solvent recovery systems include 1. Air flow, 2. Concentration of solvent, 3. Solvent type and 4. Operating continuity. For the majority of applications in a well maintained fixed bed plant, efficiencies of 97% to 98%, defined as the ratio of solvent outlet to inlet concentration over the adsorber, are quite easily achieved. In a well run fluid bed plant, efficiencies of 99%

measured over the adsorber are quite readily attainable. Other new applications for adsorption techniques include the removal of small quantities of noxious material from large volumes of air, the separation of hydrocarbon gases, and the control of SO2 emission from power station flue gases.

08371

Dratwa, Heinrich and Harald Juntgen

THE DESULFURIZATION OF FLUE GAS BY MEANS OF ADSORPTION COKES WITH VARIOUS PROPERTIES. Staub (English translation), 27(7):1-19, July 1967. 10 refs. CFSTI: TT 67-51408/7

The expected dust content in the drum waste gases, their dependence on starting material and the manufactured mixture, the specific properties of these dusts and dust removal was investigated. Plants were selected by locality, raw material, size and differing level of equipment. The results of a total of 35 individual studies at 10 plants are presented. The quantity and particle size of dust in the waste gases of the drum extends through a wide range. Three groups are seen for dust content, largely determined by whether the starting material is washed, unwashed, or processed in mixed components. Given the capacities of modern cyclone collectors it can be expected that some 85-92 percent of the dust of this composition will be retained in the first stage. Efficiency increases with increasing coarse components up to a possible 95 percent. Good wet scrubbers separate residual dust from the first stage with efficiencies of 95-96 percent. Fabric or bulk layer filters used instead of wet scrubbers can attain efficiencies aboe 99 percent. For particles of about 10 and 20 microns the settling velocities are only 0.8 and 3.2 cm/sec. Coraser particles of 40 microns settle at 12.8 cm/sec. Being stirred up by tipping processes in the drums, such particles are easily emitted with the gases. The drag of waste gases is still so great 55 70 percent, and sometimes even up to 90 percent of all dust particles in the waste gases are larger than 40 microns.

08378

Northcott, Elliott

DUST ABATEMENT AT BIRD COAL. Mining Cong. J., 53(11):29-34,36, Nov. 1967

Dust abatement methods at the Riverside preparation plant of the Bird Coal Company are described. Due to the physical location of its Riverside preparation plant, the Bird Coal Co. initiated a program of air pollution abatement that resulted in emission le vels much lower than are typical within the coal industry. Several modifications to the original flowsheet, as well as the installation of additional equipment, were necessary to complete the program. In the overall dust suppression program at Bird Coal, approximately $400,000 above the original plant cost has been expended. While it is granted that the unique location of this particular plant presented it wiht a relatively uncommon problem, the day is perhaps not too far off when every plant will be required to meet standards as stringent as those now attained at Bird Coal CO.

08429

Hangebrauck, R. P. and Spaite, P. W.

CONTROLLING THE OXIDES OF SULFUR.J. Air Pollution Control Assoc., 18(1):5-8, Jan. 1968. 25 refs. (Presented at the 6th Annual Sanitary and Water Resources Engineering Conference at Nashville, Tenn., June 1967.)

Studies of the sources of sulfur oxides pollution show that combustion of fossil fuels is responsible for 78 percent of the total emissions to the atmosphere; the remaining 22 percent comes from other industrial operations, which represent more than 22 percent of the pollution problem in terms of severe local nuisances and high ground-level concentrations. The great diversity in types and sizes of all sources requires an entire spectrum of approaches for control. The possible approaches to control are categorized to include the desulfurization of coal, desulfurization of residual fuel oil, process modification, and desulfurization of flue gas. Work on specific possibilities in each of these categories is underway both in the federal government and in industry.

08470

Zhavoronkov, N. M.

WAYS OF PROTECTING THE ATMOSPHERE FROM POLLUTION BY NOXIOUS INDUSTRIAL DISCHARGES. ((Puti zashchity vozdushnogo basseina ot zagryazneniya vrednymi promyshlennymi vybrosami.)) Text in Russian. Vestn. Akad. Nauk SSSR (Minsk), 35(10):61-65, Oct. 1965.

Various problems of air pollution from industrial waste gases are discussed. Particular emphasis is placed on pollution due to sulfur dioxide of which 18.5 million tons were discharged in Russia in 1964. When SO2 is present in high concentrations (4%), it can be directly processed into sulfuric acid. In flue gases from coal and oil combustion, however, most of the SO2 is present in concentrations below 1%. A method for the removal of sulfur from fuel has been developed in Russia, but is not considered economical. Processing of flue gases with sorbents seems to be most promising. Two methods have been developed: the magnesite method and the ammonia-autoclave method. The first is based on the absorption of SO2 from flue gases in a magnesia suspension to form a sulfite bisulfite mixture; the sulfite is removed in form of crystals. The second method is based upon absorption in aqueous ammonia to form ammonium sulfite and bisulfite. Methods for removing dust with electrostatic filters are also discussed. The removal of SO2 from power plant flue gases is considered one of the most urgent air pollution research problems.

08492

Jirele, Vratislav

EXTRACTION OF BERYLLIUM FROM POWER PLANT WASTE MATERIAL. ((Extrakce berylia z energetickych odpadu.)) Text in Czech. Chem. Prumysl (Prague), 17(4):175-179, April 4, 1967. 6 refs.

Soft coal from the Sokolov region of Czechoslovakia contains considerable amounts of beryllium which pass into the slag and fly ash when the coal is utilized in electric power plants. Significant amounts of toxic beryllium compounds are thus discharged into the atmosphere. The present study was made to investigate a process for the recovery of beryllium from slag or fly ash. Slag containing 800 gm. Be/t. and fly ash from an electrostatic filter containing 787 gm. Be/t. were used for the experiments. Dissolution of Be was tested at 25-100 deg C with HC1, NaOH, H2SO4 and HF. The latter two acids were found most effective. Slags obtained at different combustion temperatures were also tested. The use of fluoride fluxing agents was found to facilitate dissolution of the Be compounds. Separation from acidic solution was tested with solutions of di-(2-ethylhexyl) phosphoric acid (EHPA). The recommended process uses conc. H2SO4 at elevated temperatures and extraction in three stages with 0.1 M EHPA in kerosene at a pH of 2.2, resulting in complete transfer of beryllium into the organic phase. In the presence of high aluminum concentrations, a pH of 1.8 is recommended to suppress extraction of aluminum.

08574

THE PURIFICATION OF THE AIR NEAR THERMAL POWER PLANTS. ((Die Reinhaltung der Luft bei thermischen Kraftwerken.)) Text in German, Staedtehygiene (Hamburg), 16(9):203-208, Sept. 1965. (Presented at the Pro Aqua International Technical Meeting, Basel, Switzerland, March 1-7, 1965.)

At a 2,000 megawatt plant with a 200 meter chimney, sulfur dioxide air pollution under average meteorological conditions is minimal if coal containing 1 percent sulfur is used as fuel. If fuel oil containing 4 percent sulfur is used, the resulting pollution is considerable. To control the sulfur dioxide emission in stack gases, two power plants in London have utilized a wet purification method for several years. The gas was washed with river water containing a small amount of calcium, thereby converting the sulfur dioxide to calcium sulfate. Since this method is expensive, the dry purification methods (namely the adsorption on active coal and aluminum oxide) which can be used without previous cooling of the stack gases, have been attempted. So far, these methods have been used without much success.

08584

Winnacker, Karl

REMOVAL OF INDUSTRIAL WASTES AS A TECHNOLOGICAL PROBLEM. ((Be- seitigung von Industriebfaellen als technologische Aufgabe.)) Text in German. Chem. Ingr. Tech. (Weinheim), 36(1):1-8, Jan. 1964. 13 refs.

The amount of wastes from various sources and the removal or con- trol of emissions to the atmosphere are discussed. Sulfur dioxide is considered the most important pollutant. Ninety-five percent of the sulfur dioxide emitted comes from furnaces. An apparatus is illustrated which reduced the emission of sulfur dioxide from 0.2 vol.% to 0.05 vol.% in a sulfuric acid plant. Sulfur should be removed from coal and fuel oil before combustion whenever possi- ble. Several wet and dry purification methods for smoke gas are outlined. In one method illustrated the SO2 content of the uncooled gas is converted mostly to SO3 and then adsorbed on semi-coke. The sulfur dioxide was regenerated in concentrated form from the coke at 400 deg. C. Nitrogen dioxide emissions from industrial plants have become smaller in recent years due to better control methods, but automobile exhaust gases contain 5,000 p.p.m. of nitrogen oxides. A table gives the amount of various pollutants from automobile engines at the various operating conditions. Smoke and dust as well as tar vapors can be removed electrostatically.

08713

Taylor, W. G.

SMOKE ELIMINATION IN GAS TURBINES BURNING DISTILLATE OIL. Preprint, American Society of Mechanical Engineers, New York Paper 67-PWR-3, 9p., 1967. (Presented at the ASME-IEEE Joint Power Generation Conference Detroit, Mich.,Sept. 24-28,1967)

Various methods (Van Brand, Ringelmann, and Bacharach) of eval uating gas turbine smoke are described and compared. Two methods of reducting smoke in distillate-oil-fired units are evaluated. There is no single universal satisfactory system in use for evalu ating gas-turbine smoke. The Von Brand sampling technique, coupled with photometric readout eliminates weather and stack size as factors, and reduces human error. It has good repeatability and can be used to monitor machine transients. Gas turbines can be made to satisfy all codes by use of fuel additives or air atomiza tion. Within a few years the only satisfactory stack will be one which is invisible. This can be achieved now, except for start-up with a combination of air atomization and a small quantity of fuel additive.

08825

Zentgraf, Karl-Martin

CONTRIBUTION TO SO2 MEASUREMENT IN FLUE GASES AND TO FLUE GAS DESULFURIZATION BY COMBINATION WITH ALKALINE EARTH METALS. ((Beitrag zur SO2-Messung in Rauchgasen und zur Rauchgasentschwefelung mit Verbindungen der Erdalkalimetalle.)) Text in German. VDI (Ver. Deut. Ingr. Ingr.) Z. (Duesseldorf), 109(35):1689, Dec. 1967.

An infrared absorption apparatus was used for the determination of the amount of SO2 in flue gases. The parts of the apparatus were constructed of Teflon, quartz or polyethylene to prevent the absorption or adsorption of SO2. The transverse strain sensitivity of the apparatus towards CO and CO2 was removed by a modification of the apparatus, and the water content of the gas was reduced by means of a sulfuric acid drip column. The apparatus proved feasible technologically, but since its involved calibrations require the use of specially trained personnel it presents economic difficulties. Experiments for the desulfurization of flue gases were conducted in a coal-fired wet bottom boiler with a steam capacity of 110 t./hr. A desulfurization of 26-31% was obtained with a double stoichiometric addition of dolomite-calcium hydroxide at a flue gas temperature of 1150 deg C. A 19-29% desulfurization effect was obtained with the 1.2 times stoichiometric addition of limestone meal (particle size 95% less than 90 micro m at a flue gas temperature of 1500 deg C. It is not practical to use desulfurization with fly dust recyclization, since the sinter products of the desulfurization compounds cause excessive amounts of dirt. By the use of calcium hydroxide, 70% of the SO2 is bound as the sulfate and 30% as the sulfite and the dust discharge is smaller with the use of a desulfurization compound without fly dust recyclization than during normal vessel operation with fly dust recyclization. The cost of the various desulfurization compounds is briefly discussed.

08836

Slack, A. V.

AIR POLLUTION: THE CONTROL OF SO2 FROM POWER STACKS. PART III--PROCESSES FOR RECOVERING SO2. Chem. Eng., Vol. 74, p. 188-196, Dec. 4, 1967. 4 refs.

The technology and economics of ten major processes for recovering sulfur oxides from power stations are reviewed. These processes are: manganese dioxide (Mitsubishi); ammonia (Showa Denko); alkalized alumina; lignite ash (Still); mixed metal oxides (Grillo); Monsanto-Penelec; Kiyoura-T.I.T.; sulfacid (Lurgi); Hitachi; and Reinluft. All of these fit into three process types: adsorption, absorption and catalytic oxidation. Large-scale tests now under way or planned for these recovery processes are described and their potential impact on the fertilizer industry is evaluated. Other proposed methods now being investigated on a small scale are also reviewed.

08863

Reese, J. T. and Joseph Greco

EXPERIENCE WITH ELECTROSTATIC FLY-ASH COLLECTION EQUIPMENT SERVING STEAM-ELECTRIC GENERATING PLANTS. J. Air Pollution Control Assoc., 18(8):523-528, Aug. 1968. 8 refs. (Presented at the Winter Annual Meeting and Energy Systems Exposition, American Society of Mechanical Engineers, Pittsburgh, Pa., Nov. 12-17, 1967, Paper 67-WA/APC-3.)

Some of the variables which have affected performance of TVA electrostatic collectors installed at Kingston Steam Plant and later units installed at Widows Creek and Colbert Steam Plants are discussed. Exit gas temperatures, sulfur in the fuel, and acid dewpoint are interrelated variables which exert pronounced effects on electrostatic fly-ash collectors. When operating with flue gas at temperatures above the acid dewpoint, collector efficiency declines as sulfur in the fuel decreases below about 2.0 percent. When operating with flue gas at temperatures below the acid dewpoint, performance is sharply reduced by trace amounts (1-2 ppm) of condensed sulfuric acid. The exact mechanism by which condensed H_2SO_4 in flue gas affects precipitator performance is not known; however, test results indicate that the acid may condense in such a manner to alter electrical properties of the flue gas or fly ash. For those units which are designed to operate below the acid dewpoint, collector performance is restored to acceptable levels by operating with elevated gas temperatures. Unfortunately, the loss in boiler efficiency makes the economics of this approach unattractive. Collector performance can also be restored on units operated below acid dewpoint by the addition of small quantities (5-15 ppm) of ammonia to the flue gas. The economics of this method are more favorable than other remedial measures considered.

08870

Goldberger, W. M.

COLLECTION OF FLY ASH IN A SELF-AGGLOMERATING FLUIDIZED-BED COAL BURNER. American Society of Mechanical Engineers, New York, N. Y., United Engineering Center, 67-WA/FU-3, 16p., 1967. (Presented at the Winter Annual Meeting and Energy Systems Exposition, American Society of Mechanical Engineers, Pittsburgh, Pa., Nov. 12-17, 1967.)

High combustion efficiency and effective ash collection was observed in bench-scale and pilot-plant fluidized-bed coal burners. The efficiency of burning pulverized coal was found to exceed 99 percent. The fluidized-bed coal burners were operated in a self-agglomerating manner to retain up to 90 percent of the ash fed with the coal. The coal burner system, which included the fluidized-bed burner plus an external cyclone, was capable of removing up to 99 percent of the ash fed and produced hot gases with significantly less dust loading than the effluent from conventional coal-burning equipment. A bituminous, Pittsburgh No. 8 coal and a subbituminous coal from Lake de Smet, Wyo., were used in the study. The ash from both coals was readily agglomerated and retained in the fluidized-bed burner. Collection of fly ash and agglomeration and growth of the bed particles occurred at temperatures as low as 140 F, although the collection efficiency was not high below 1900 F. The ash collection rate increased rapidly above 1900 F, but above 2100 F the sticking tendency of the bed was too great for stable fluidization. A semilogarithmic relationship was developed for correlating the observed data and for use in process design and economic evaluation. Dust removal efficiencies calculated by this relationship were found to agree with experimental values to within plus or minus 6.45 percent, which was of the order of the experimental errors involved. (Author's abstract)

08898

Kester, William M., Joseph W. Leonard, and Edwin B. Wilson

REDUCTION OF SULFUR FROM STEAM COAL BY MAGNETIC METHODS. West Virginia Univ., Morgantown, Coal Research Bureau, CRB-31, ((21))p., 1967. 11 refs. (Presented at the Coal Show of the American Mining Congress, Cleveland, Ohio, May 15-18, 1967.)

A high-intensity, magnetic separator was used for the dry magnetic concentration of Upper Freeport, Redstone, Sewickley and Pittsburgh coal seam samples. The feed size range, the separator side slope setting and the intensity of the magnetic field were varied in order to determine conditions for optimum separation. Upper Freeport coal yielded an excellent average pyritic sulfur reduction from 1.44 to 0.28 percent. The average total sulfur content was reduced from 2.58 to 1.09 percent. The average Upper Freeport ash is shown to be reduced from 16.37 to 11.33 percent. An average reduction of pyritic sulfur from 1.07 to 0.53 percent in Redstone coal was achieved. Average sulfate content was reduced from 0.13 to 0.05 percent but organic sulfur content did not decrease. Pyritic sulfur in Sewickley coal was reduced from 1.27 to 0.52 percent and sulfate sulfur from 0.16 to 0.05 percent. Organic sulfur was reduced from 1.30 to 1.24 percent. Total sulfur was reduced in these experiments from 2.73 to 1.81 percent. Sewickley coal, like the Upper Freeport coal, responded to magnetic separation with an approximate 5 percentage point reduction in ash, the most favorable ash reduction of the four coals tested.

08908

Squires, Arthur M.

AIR POLLUTION: THE CONTROL OF SO_2 FROM POWER STACKS. PART IV POWER GENERATION WITH CLEAN FUELS. Chem. Eng., 74(26):101-109, Dec. 18, 1967. 35 refs.

The technology of two-stage combustion processes for removal of sulfur from coal and residual fuel oil to be utilized in steam plants is analyzed. In two-step combustion a first gasification stage would yield a flue gas containing hydrogen sulfide. From this elemental sulfur would be recovered and the clean fuel gas burned in a second combustion step. Various processes which might be adapted to this two-step combustion are considered in some detail.

08917

Squires, Arthur M.

AIR POLLUTION: THE CONTROL OF SO_2 FROM POWER STACKS. PART I - THE REMOVAL OF SULFUR FROM FUELS. Chem. Eng., 74(23):260-268, Nov. 6, 1967. 35 refs.

The first of four articles on the curbing of air pollution through the control of sulfur dioxide emission from power station flue stacks looks into the technology and economics of removing sulfur from fuels before they are burned. The progress of work on desulfurization of fuel oil and coal both here and abroad is traced. While desulfurization processes have been developed, they do not appear to offer an early, cheap solution to the SO_2 problem of the power station.

08919

Snyder, M. Jack

FLY ASH: SPECIFICATIONS, LIMITATIONS, AND RESTRICTIONS. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 37-45. 9 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

Specifications for fly ash are usually expressed in terms of certain readily measurable characteristics of the fly ash which the specifiers have reason to believe are indicative of the properties that will be achieved in products made from fly ash. The selection of characteristics to be measured has been based on a wide variety of foundations, ranging from the results of extensive testing programs to rather arbitrary assumptions that a given charac teristic is significant. A complication in determining whether a particular fly ash is suitable for a proposed application is the fact that different specifying bodies do not agree on specifica tions. Specifications for fly ash used as an ingredient in con crete are outlined as established by ASTM, the Bureau of Re clamation, British Standards, New York City, and Chicago. Information developed in a number of research programs on fly ash has led to doubts not only about the significance of some of the characteristics being measured but also about the validity of some of the methods used to measure the characteristics. Some new characterization methods that may be more meaningful as a basis for specifying fly ash are suggested. The results have shown that fly ash has several distinct functions in concrete. It is (1) a pozzolan, (2) a workability modifier, (3) a fine aggregate, and (4) an adsorbent of air-entraining agents.These effects are discussed in terms of their significance for specifications.

08921

Skaggs, H. C., and R. E. Morrison

PRODUCING SPECIFICATION FLY ASH. In: John H. Faber, John P Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 52- 57. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa. March 14-16, 1967.) GPO: 3-268-468

Experiences of the Kanawha River Power Plant in producing specification fly ash are discussed. Tests made on Kanawha fly ash showed the loss on ignition varied from 3.6 to 4.90 percent. Specific gravity was about 2.20 and Blaine specific surface was between 1,800 and 2,000 square centimeters per gram. The combin ation of silica, alumina and iron oxide varied between 93.8 and 95.2 percent. The big variable that could be controlled was loss on ignition. Coal fineness was increased from 70 to 85 percent passing a 200-mesh sieve. This increase in coal fineness helped reduce loss on ignition but did not change Blaine finess. Routine test on pulverizer performance was set up whereby the output of the pulverizer versus primary air flow was plotted. These tests not only revealed pulverizer performance, but helped keep the fires balanced, thus further reducing loss on ignition. It was previously noted in takingfly ash samples that changes in boiler-firing techniques showed up quite readily in the color of the fly ash. Cyclone samplers were installed on each of the venturi sections of the three boiler-outlet ducts on both units. Each sampler was changed every two hours according to a fixed schedule posted on a specially painted sample board. The sample board is painted a gray color which represents 2 percent loss on ignition. With this guide the operator can effectively take corr ective measures when necessary. Loss on ignition has now been improved from a former range of 0.6 to 4.90 percent to a present range of 0.5 to 1.28 percent to meet fineness and pozzolanic activity requirements of ASTM Designation C-350, and U.S. Army Corps of Engineers Specification CRD-C-262. A Hardinge-type ball mill was installed. The mill takes raw fly ash with a specific gravity of 2.20, Blaine fineness of 1,800 to 2,000 square centimeters per gram and changes to a specification fly ash with a specific gravity of 2.45, Blaine finess of 2,800 to 3,000 square centimeters per gram or surface area of 6,800 to 8,500 square centimeters per cubic centimeters. Pozzolanic activity was increased from a former 7-day strength of 650-750 psi to 1,240- 1,585 psi.

08922

Zimmer, F. V. 08922 125

PROBLEMS IN FLY ASH MARKETING. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C. Bureau of Mines, 1967, p. 58-68. 1 ref. (Presented at the Edison Electric Institute, National Coal Association, Bureau of $mines Symposum, Pittsburgh, Pa., March 14-16, 1968.) GPO: 0-268-468

Many possible uses for fly ash have been tried. Most of them have been discarded as either unsuccessful or uneconomic. A few, however, have either developed into actual markets or are thought to have considerable promise. Some of the present major markets in the United States are: (1) Mineral filler in asphalt paving, (2) Cement replacement in concrete, (3) Cement replacement in concrete products, (4) Constituent in portland ce,emt, (5) Pozzolan in soil stabilization, (6) Raw material in lightweight aggregate, (8) Fill for land development or compacted embank ments, (8) Pozzolan in portland-pozzolan cement, and (9) Grouting agent in oil well cementing. These major markets along with other smaller markets utilize approximately 1.5 million tons per year in the United States. The rest is dumped. It is extremely difficult for any suppliers to develop markets capable of utilizing total production. Problems commonly faced by supplier marketing fly ash are discussed for some of the markets listed. Overall marketing problems include: meeting specifications; transportation rates; color; and handling.

08923

Philleo, Robert E.

FLY ASH IN MASS CONCRETE. In: John H. Faber, John P. Capp and John D. Spencer (compilers), Fly Ash Utilization. BM- IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 69-79. 4 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa. March 14-16, 1967.) GPO: 0-268-468

Mass concrete in any volume of concrete cast in place and intended to resist applied loads by virtue of its mass. It is the material used in concrete dams, flood walls, retaining walls, navigation locks, and more recently, reactor shields. Advancements in the technology of mass concrete have been directed primarily to the reduction in the amount of cement in the concrete. The technical incentive for reduction in cement content is concerned with the generation of heat within the concrete. The principal disadvant age to the use of fly ash in most concrete construction--slow early strength development--is not a disadvamtage and in some ways may be an advantage in mass concrete. Mass concrete generally is not highly stressed. In most cases it carries little more than the stress produced by its own weight. That stress is applied slowly as the structure is built; as a result early strength is not re quired. The reduction in heat of hydration at 28 days when fly ash is introuduced in concrete is a reflection of this delayed strength development. While the heat ultimately generated in fly ash concrete may be comparable to the heat generated in concrete without fly ash, just as the strength ultimately attained by fly ash concrete is as great as the strength attained by concrete without fly ash, a portion of the heat generation is deferred until the center of the mass has started to cool. Hence, the peak temperature is reduced as is the temperature drop to ambient. The use of fly ash in mass concrete by the Bureau of Reclamation, Corps of Engineers, Hydro-Electric Power Commission of Ontario, and the Tennessee Valley Authority is reviewed.

08925

Hester, J. A.

FLY ASH IN ROADWAY CONSTRUCTION. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC 8348, Washington, D. C., Bureau of Mines, 1967, p. 87- 100. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa. March 14-16, 1968.) GPO: 0-268-468

The use of fly ash in Alabama for highway construction is review- ed. Fly ash has been used in three types of construction: Lime fly ash base course stabilization, concrete bridges, and concrete pavement. The additional strength of concrete made with fly ash results from the elimination of part of the sand from the concrete mixture and reaction of the fly ash with the cement. The additio nal workability not only permits removal of sand but allows replacement of the excluded portion of sand with an equal volume of coarse aggregate. Concrete containing fly ash displays no advantage over concrete without fly ash in freezing and thawing and the use of corrosive deicing salts. A sufficient volume of entrained air in the concrete should correct this deficiency. Exposure to sulfate in sea water of the encasements of several older bridges in concrete containing fly ash seems to confirm the findings published in other reports that fly ash is an aid in preventing attack from sulfates, at least in solutions of low sulfate concentrations. High flexural strength in concrete pave ment containing fly ash can be obtained even with mixtures of lower than average cement factors. Test from the concrete pavements support existing data showing that higher flexural strength can be obtained from concrete containing a good grade of crushed lime stone coarse aggregate than from concrete containing siliceous gravel, even with much higher cement content of the gravel mixtures. Field tests on concrete pavement containing fly ash show volume change results very similar to that expected from average concrete without fly ash when the water-cement ratio is not excessive.

08926

Belot, Joseph R., Jr.

FLY ASH IN CONCRETE AND CONCRETE BLOCK MANUFACTURING. In: John H. Faber, John P. Capp, and John D, Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 101-106. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The use of fly ash in the concrete and concrete block industry is reviewed. Fly ash is used in this industry because up to 25 percent of cement at 20 dollars per ton can be replaced with fly ash at 6 dollars per ton and at the same time retain strength, de crease shrinkage and increase workability. Problems in handling fly ash, the importance of maintaining constant quality fly ash, and the promotion of fly ash in concrete blocks are briefly discussed.

08936

Shafer, H. E., Jr., C. F. Cockrell, K. K. Humphreys, and J. W. Leonard

STATUS REPORT ON BRICKS FROM FLY ASH. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines 1967, p. 195-203. 4 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Sym- posium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The Coal Research Bureau at West Virginia University, has developed a process to produce quality, dry-pressed fly ash-based brick which conceivably can utilize large tonnages of ash without much regard to physical and chemical properties of the ash. Through experimentation, it was found that a fly ash content of approximately 74 percent combined with about 23 percent coarser aggregate and 3 percent sodium silicate binder, on a dry basis, appeared to yield a satisfactory product. Many powerplants, in addition to producing fly ash, also produce a coarser bottom ash or slag. By using bottom ash or slag as the coarser aggregate in the mix, a fortuitous improvement both economically and technically, bricks can be produced containing about 97 percent coal ash. In areas where slag is unavailable, agglomerated fly ash, coarser coal refuse, or sand will suffice as an aggregate since physical rather than chemical characteristics exert the main influence on the final fired product. As a result of using the optimization program for a particular fly ash, brick of better quality than those previously reported can be produced by slight changes of test variables. The encouraging results of the initial developmental research prompted the construction and operation of a full-scale facility to evaluate the commercial feasibility of the process. A diagram of the proposed equipment layout and the proposed flow of raw materials to the finished product is given

08937

Hoy, L. W.

CONSUMER ECONOMICS: USE OF FLY ASH IN CONCRETE. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 204-209. (Presented at the Edison Electric Institute, National Coal Association Bureau of Mines Sym- posium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

Fly ash, used as an admixture and properly proportioned with the cement, water, and aggregates, can be added economically to produce a more workable plastic consistency yet does not reduce the con crete strengthcharacteristics. To accurately evaluate and im plement the possible use of fly ash as an admixture to concrete, a testing program was initiated. Design mixes were calculated and tested. The results are presented in table form. The fly ash concrete information obtained as a result of laboratory design, testing, field testing, and mill use indicates an economic advan tage in many facets of construction. Some of the more economi cal advantages realized are as follows: (1) With the addition of fly ash, less water was required to obtain fluidity and worka bility. The 5,000-psi ultimate strength concrete averaged almost 2 gallons of water per cubic yard less than the same concrete mix without fly ash, for a total of approximately 4 gallons of water per cubic yard. (2) Fly ash particles have a somewhat spherical configuration. This configuration results in a ball-bearing effect, which allows the fly ash to flow into voids created by the imperfect mating of the coarse and fine aggregates with greater freedom and less friction. (3) The pouring and finishing time of fly ash concrete can be reduced. On pours of 200 to 450 cu yd of concrete per day, the finishing time was reduced by 1 to 3 hours with greater workability being evident. (4) With the substitution of 100 lb of fly ash and the reduction of one bag of cement (94 lb) the net savings is 60 cents/cu yd of concrete to the Weirton Steel Co.

08938

Capp, John P. and Carl F. Engle

FLY ASH IN AGRICULTURE. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization.

BM- IC-8348, Washington, D.C., Bureau of Mines, 1967, p. 210-220. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The results of studies by various groups using raw fly ash and sintered fly ash as a soil additive are summarized. Fly ash makes the soil more friable, easier to work and increases the pH and boron content. It can be used at a rate of 200 tons per acre in growing corn and as a plant cover to prevent blowing on fly ash disposal areas. Potatoes grown in fly ash-soil mixtures are larger, smoother and without scab. The harvest of rye, alfalfa, and crimson clover grown in sintered bly ash-soil mixtures was greater than that of plants grown in control soil or sintered fly ash alone, with a progressive increase in harvest weight accompany- ing an increase in percentage of sintered fly ash. Field experi ments using fly ash in an acid surface-mine spoils plot, considered a 'problem area' by the U.S. Department of Agriculture Soil Conservation Service are reported in detail. The plot was suit able for growing alfalfa after conditioning with raw fly ash.

08939

Smith, Dwight K.

UTILIZATION OF FLY ASH IN THE CEMENTING OF WELLS. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 221-234. 5 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

Mixtures of fly ash and cement have been used throughout the United States, Canada, and Europe since its introduction to the oil industry in 1949. Thousands of wells have been successfully cemented with this composition and the total consumption of fly ash has exceeded thirty million sacks. Due to its special properties, it has had wide usage under diversified field conditions. Labor atory data on fly ash-cement blends have been widely supported by field performance to obtaine (1) lighter wright, (2) improved economics, (3) resistance to corrosion, (4) low heat of hydration, (5) low permeability, (6) improved flow properties, and (7) a very ideal material for downhole applications. (Author's summary, modified)

08940

Bergemann, Georg O.

USE OF FLY ASH IN SPECIALIZED CONCRETE WORK. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967,p. 235-249. 8 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The utilization of fly ash in the Prepakt (preplaced aggregate) process is reviewed. Prepakt concrete is produced by preplacing in the forms clean coarse aggregate and filling the voids in the aggregate with Intrusion mortar. Intrusion mortar is composed of portland cement, fly ash, Intrusion, a water reducer agent and water sufficient to produce a fresh mortar of thick cream con sistency. Preplaced aggregate concrete when aided by fly ash is superior to conventional concrete with respect to compressive, tensile, flexural, and bond strength, moduli or rupture and elas ticity; drying shrinkage, permeability; resistance to weathering; and resistance to acids, alkalies, and sulfates. A few examples of well known structures which employed the preplaced aggregate method of concreting with the use of fly ash are: The Mackinac Bridge, a four-lane toll bridge across the Straits of Mackinac which provides a physical link between the two peninsulas of the State of Michigan; the first manmade radar island, Texas Tower No. 2, which was located in the Atlantic Ocean and served for 7 years as part of this country's radar warning systems; the under- water launching pad off the California coast for early experiments performed with the Navy's solid-fueled Polaris missile; and the Minuteman Missile Base at Malmstrom Air Force Base, Montana. Whether it be in new construction or in rehabilitating existing masonry and concrete structures, the Prepakt system has a generic term in worldwide construction--thanks to the beneficial properties of fly ash.

08942

Mielenz, Richard C. and year-to-year market. The importance of fly ash suppliers in

ASTM SPECIFICATIONS ON FLY ASH FOR USE IN CONCRETE. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 271-286. 23 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The American Society for Testing and Materials (ASTM) has promulgated and approved three standards that cover fly ash for use in concrete in which the binding medium is wholly or in part portland cement. ASTM Designation: C 350, Specifications for Fly Ash for Use As An Admixture in Portland Cement Con crete; ASTM Designation: C 311, Methods of Sampling and Testing Fly Ash for Use As An Admixture in Portland Cement Concrete, and ASTM Designation: C 340 comprises Specification for Portland-Pozzolan Cement for which certain fly ashes will meet requirements on the pozzolan component. Their development and significance are summarized. These specifications have been modified as data and new test procedures became available. Addi tional changes are contemplated and others may be expected in future years. Neither of these standards sets forth procedures or recommendations on the proportioning or control of concrete mix- tures in whch the fly ash admixture or blended cement may be em ployed. Decisions on techniques of use depend upon the character istics of the available concrete-making materials, the properties to be developed in the concrete, and relative cost of alternative mixtures at the site of the work.

09163

Knecht, H., W. W. Moore, and F. W. Schmitz

PERFORMANCE RESULTS ON PARTICULATE REMOVAL UPSTREAM OF AN AIR HEATER WHEN BURNING FUEL OIL. In: Proc. Am. Power Conference, 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966, Vol. 28, p. 525-533.

To improve the appearance of the stack emissions from a steam plant with oil burning units, an electrostatic precipitator was studied. The electrostatic collector was located ahead of the air heater with operating temperatures between 600 degrees F and 700 degrees F. A mechanical collector was also used which could be located either before or after the electrostatic section. An electrostatic precipitator, with properly designed ventilation for preventing acid formation in the insulator compartment, could be expected to perform at efficiencies of 90 percent or above, on boilers burning fuel oil. The performance of the precipitator would likewise be at this level with the additive (MgO) used. The material collected at high temperature (600 F to 700 F) will be very low in density and free flowing to hopper discharge. The material will also be extremely hygroscopic. The removal of this solid material should have an appreciable reduction on the deposition of this material in the ductwork, stack and surrounding neighborhood. There is some evidence stack appearance may be improved because of the high SO3 content in the collected material. The performance of the mechanical collector was not sufficient to warrant its consideration for full scale operation.

09191

J. L Burdock

FLY ASH COLLECTION FROM OIL-FIRED BOILERS. Preprint, UOP Air Correction Div., Greenwich, Conn., 15p., 1966. 4 refs. (Presented at the 10th Annual Technical Meeting of the New England Section of APCA, Hartford, Conn., April 21, 1966.)

Centrifugal separators are generally preferred for collecting fly ash emissions from oil-fired boilers. Selection of centrifugal collectors depends on three things--size distribution of the particulate matter, the characteristics of the cyclone, and the degree of clean-up required. Purchasers of new or replacement boilers and collection equipment can be sure of getting equipment suitable for the job by exerting more control over equipment specifications. For the best results, collection equipment should be designed on the basis of careful ash analysis, knowledge of additives to be used, and the use of guaranteed rather than anticipated micron efficiency curves.

09195

Katherine C. Hellwig

LIQUID FUELS FROM COAL WITH H-COAL. Preprint, Hydrocarbon Research, Inc., New York, 6p., 1966. (Presented at National Coal Association Technical-Sales Conference and Bituminous Coal Research, Inc., Annual Meeting, Sept. 14-15, 1966, Pittsburgh, Pa.)

The H-Coal process is based upon a new reactor concept known as the ebullated bed reactor. Dried and pulverized coal is combined with recycled oil to form a slurry. This slurry is fed continuously with hydrogen into a reactor containing a bed of ebullated catalyst. The coal is catalytically hydrogenated and converted to liquid and gaseous products. Products are separated and result in fractions of gas, light distillate, middistillate, and vacuum bottoms slurry. In this reactor system 90% of the coal on the moisture and ash-free basis is converted to liquid and gaseous products. Liquid products from the coal hydrogenation step are hydrocracked, hydrotreated, and reformed to produce gasoline, No. 2 furnace oil, and a very small amount of No. 6 fuel oil. All of the No. 2 furnace oil can be converted to gasoline if desired. Benzene and liquid petroleum gas (LPG) may be recovered and sold. An economic summary for an H-Coal refinery with a nominal capacity of 1000,000 barrels per standard day (BPSD) is presented. Three cases are presented. The first case produces gasoline and furnace oil in a ratio of 2 to 1. The second case produces all gasoline, and the third case is the same as the second case with the exception that 12,000 BPD of LPG and 3000 BPD of benzene are recovered. Based on the progress made in development of the H-Coal process it is expected to be ready for commercialization in the early 1970's and will provide the coal industry with a means to compete for the gasoline market and to utilize the large reserves of high-sulfur fuel.

09469

Pearson, R. B. and D. B. Leason

INSULATION OF TALL BRICK-LINED CONCRETE CHIMNEYS. J. Inst. Fuel, 39(301): 68-88, Feb. 1966

An account is given of a study carried out some years ago on the chimneys at Belvedere Power Station. The heat losses from the chimney were studied theoretically and experimentally with a view to minimizing acid deposition within the chimney. The diffi culties in obtaining experimental results from a large chimney are emphasized and the results discussed. The theoretical findings suggested that a substantial recuction in heat losses could be achieved if the air annulus wws filled with vermiculite. The practical realization of this insulated chimney is described to gether with the subsequent measurements of gas and lining temperatures which permitted the more economic operation of the boilers without increasing the likelihood of acid deposition. (Authors' abstract)

09496

E. P. Stastay

SPECIFICATIONS FOR ELECTROSTATIC PRECIPITATOR COLLECTORS FOR FLY ASH COLLECTION ON INDUSTRIAL STEAM PLANTS. Preprint, Indus- trail Gas Cleaning Institute, Inc., 12p., 1966. (Presented at the Industrial Coal Conference, Purdue University, Lafay- ette, Ind., Oct. 12, 1966.)

Criteria necessary for choosing among several electrostatic pre- cipitators submitted as bids on a company purchase offer are dis cussed. Final stack gas composition and appearance, precipitator cost, installation costs, associated equipment (ductwork, insula tion, supporting structure, etc.) costs, and safety aspects are considered.

09523

Geer, M. R.

PREDICTED RESULTS OF CLEANING APPALACHIAN COALS AT LOW DENSITY FOR PREDICTED RESULTS OF CLEANING APPALACHIAN COALS AT LOW DENSITY FOR SULFUR REDUCTION. Department of the Interior, Washington, SULFUR REDUCTION. Department of the Interior, Washington, D. C., Bureau of Mines, RI-7098, 20p., 1968. 14 refs. D.C., Bureau of Mines, RI-7098, 20p., 1968. 14 refs.

The Bureau of Mines examined the washability data for 25 Appa-

The Bureau of Mines examined the washability data for 25 Appalachian coals requiring low-density washing to reduce sulfur lachian coals requiring low-density washing to reduce sulfur con- tent to 1%, using the distribution-curve method. The purpose was content to 1 percent, using the distribution-curve method. The purpose was to estimate how closely theoretical sulfur values could to estimate how closely theoretical sulfur values could be approached. what yields of washed coal could be expected, and the be approached, what yields of washed coal could be expected, and the recovery efficiencies that might be achieved. Assuming that recovery efficiencies that might be achieved. Assuming that the run-of-mine coal would be crushed to 3/8 in. and cleaned in dense- the run -of-mine coal would be crushed to 3/8 in. and cleaned in dense-medium cyclones, the calculations indicate that theoretical medium cyclones, the calculations indicate that theoretical sulfur contents could be approached closely when cleaning at specific sulfur contents could be approached closely when cleaning at a specific gravity of separation as low as 1.30. With coals that gravity of separation as low as 1.30. With coals that have favor able specific gravity compositions the recovery efficiency antici have favorable specific gravity compositions the recovery efficiency anticipated for cleaning at 1.30 specific gravity is pated for cleaning at 1.30 specific gravity is surprisingly high. Similar calculations for cleaning with concentrating tables at surprisingly high. Similar calculations for cleaning with concentrating tables at intermediate specific gravities indicated intermediate specific gravities indicated that theoretical sulfur contents at 1.50 specific gravity could be approached closely with that theoretical sulfur contents at 1.50 specific gravity could be approached closely with some coals but not with others. some coals but not with others. The calculations suggest that operating a table at a specific gravity of separation much lower The calculations suggest that operating a table at a specific gravity of separation much lower than about 1.50 probably would be than about 1.50 probably would be unsatisfactory with most coals. unsatisfactory with most coals.

09546

Fernandes, John H., W. Burton Daily, and Robert H. Walpole, Jr.

COAL FIRED BOILER EMISSIONS AND THEIR CONTROL BY THE TWIN CY- CLONE. Combustion, 39(8):24-29, Feb. 1968. (Presented at the Industrial Coal Conference, Lafayette, Ind., Oct. 11-12, 1967.)

In evaluating the standard dry dust collection equipment available today, there is an area of performance capability between the con ventional high efficiency mechanical dust collector and the perfor- mance levels of other types of collection equipment which is not fulfilled. In many instances, this area of performance will suc cessfully comply with air pollution control regulations to be enacted in the future. It is in this range of 85 to 95 percent collection efficiency on dust similar to coal fly ash that the Twin Cyclone mechanical dust collector can be most successfully applied. The performance capabilities of the Twin Cyclone mechanical dust collector have been verified through extensive laboratory and field testing programs. The achievement of this high level of performance in a mechanical dust collector has neces- sitated a more sophisticated design with many exclusive features. The performance level of a mechanical dust collector in separating particulate matter is primarily dependent on particle size and particle density. For this reason. the results obtained in the field tests on fly ash collection can be applied to other fuels and materials as an effective air pollution control method or for pro duct recovery. To date, the company has laboratory tested the performance of the Twin Cyclone on such materials as bark char, phosphate dust, begasse ash, sawdust ash, and salt cake. The suc cess of these laboratory tests has confirmed the ability of the Twin Cyclone to attain exceptionally high performance in numerous exceptionally high performance in numerous fields of particulate fields of particulate collection. (Authors' summary)

09600

Sherwood, P. T. and M. D. Ryley

THE USE OF STABILIZED PULVERIZED FUEL ASH IN ROAD CONSTRUCTION. (A LABORATORY INVESTIGATION.) Ministry of Transport, Great Britain, Road Research Lab., RRL-49, 44p., 1966. CFSTI: PB 176672

The report is divided into four parts consisting of: a study of the variation in the physical and chemical properties of pulverized fuel ash; an investigation of the use of mixtures of lime and p.f.a. as stabilizing agents for natural soils; an assessment of the suitability of p.f.a. for stabilization with lime or cement; and an examination of the self-hardening properties of p.f.a. The investigations show that pulverized fuel ash is suitable for use in the construction of road bases and sub-bases. It is a cheap and readily available material and its use will help to reduce the demand for natural aggregate in Great Britain and at the same time eliminate the disposal problems that are encountered at power stations. (Authors' abstract)

09607T

Veverka (No initials given)

DESIGN OF AN AMMONIACAL DESULFURIZATION UNIT FOR 100 MW. ((Entwurf einer ammoniakalischen Entschwefelungsstrasse fur 100 MW.)) In: Proceedings of the International Symposium on Air Purification and the Utilization of Sulfur Dioxide and Fly Ash from Steam Power Plants, Liblice, Czechoslovakia, Oct. 1965, p. 98-104.

A method is presented whereby SO2 is removed from power plant stack gases with ammonia scrubbing. The gases, containing 0.15 to 0.30 mole-percent SO2, are cooled to 160 Degrees C, washed in a 'bicyclic' (two-stage) scrubbing system, reheated to increase subsequent thermal plume rise, and then exhausted. The absorption solution is regenerated by boiling. SO2 in the resulting vapor is condensed and dried with H2SO4. Ammomium sulfate is a by-product. The following topics are discussed qualitatively: corrosion, system heat balance, heat conservation, fly-ash removal, materials of construction, and economics.

09666

Perry, Harry and J. H. Field

COAL AND SULFUR DIOXIDE POLLUTION. American Society of Mechanical Engineers, New York, Paper 67-WA/PID-6 9p., 1967. 19 refs. (Presented at the Winter Annual Meeting and Annual Meeting and Energy Systems Exposition, Pittsburgh, Pa., Nov. 12-17, 1967.)

The scope of the air pollution problem in the U. S. is briefly reviewed. Sulfur oxides comprise less than 15 percent of total emissionsk but are of considerable present interest because most arise from combustion of relatively low-cost coal and residual oil. Emission limitations for sulfur oxides in several areas are cited. Ten general methods are enumerated to reduce urban levels of sul fur oxides and their applicability is discussed. An up-to-date review is given of methods to remove sulfur from coal prior to combustion, of injection of limestone or dolomite into the boiler for in-process sulfur oxides removal, and of processes to remove sulfur oxides from stack gases. (Authors' summary)

09699

R. J. Bender

TALL STACKS, A POTENT WEAPON IN THE FIGHT AGAINST AIR POLLUTION. Power, 111(11):94-96, Dec. 1967.

Tall stacks for public utilities and industrial plants are an effective remedy against agseous pollution. While they do not, obviously, prevent pollutant from reaching the atmosphere, their diffusing action is such that they reduce contamination at ground level, to a degree aceptable to the public as well as to most governing bodies. For example, a chimney can be sized so as to limit the ground concentration of sulfur oxides at ground level, anywhere around the plant, to around one-tenth part per million, which is satisfactory to everyone. (Author's introduction)

09788

Simon, Herbert

BAGHOUSES. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 106-135, 1967. GPO: 806-614-30

When high collection efficiency on small particle size is required, the most widely used method consists of separating the dust from the air by means of a fabric filter. The fabric is usually made into bags of tubular or envelope shape. Filter fabrics normally used to remove dust and fumes from airstreams are usually woven with relatively large open spaces, sometimes 100 microns or larger in size. Small particles are initially captured and retained on the fibers of the cloth by means of interception, impingement, diffusion, gravitational settling, and electrostatic attraction. Once a mat or cake of dust is accumulated, further collection is accomplished by sieving as well as by the previously mentioned mechanisms. The cloth then serves mainly as a supporting structure for the dust mat responsible for the high collection efficiency. Selecting or designing a baghouse requires the following initial steps: The minimum volume to be vented from the basic equipment must be determined according to the principles set forth elsewhere in this manual; A maximum desirable baghouse resistance must be estimated; The blower operating point is selected to provide the minimum required volume at the maximum baghouse resistance; A minimum baghouse resistance is estimated for the condition immediatly after the filter bags are thoroughly cleaned; A second operating point on the blower characteristic curve is determined for the clean bag condition; The minimum filtering area required Ohio, National Center for Air Pollution Control, PHS-Pub- particular dust or fume being collected; The calculations are rechecked, with the filtering area thus determined to ensure compatability; Recommended maximum filtering velocities and minimum dust-conveying velocities for various dusts and fumes are listed. The filtering media selected for use in a baghouse must be compatible with the temperature and pH of the effluent. Maximum permissible temperatures and chemical resistance are listed for the various filters normally used for filter media in dust collectors. Typical specifications for a few glass filters are also listed. The installation and cleaning of filters; disposal of collected dust; and baghouse construction and maintenance are discussed in detail.

09789

Simon, Herbert

SINGLE-STAGE ELECTRICAL PRECIPITATORS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 135-156, 1967. GPO: 806-614-30

The history of electrostatic precipitation, its advantages and disadvantages, diverse applications, and mechanism are discussed. The mechanisms involved in electrical precipitation are treated in detail providing pertinent information on the following: construction; voltage for successful operation (rectifiers, effects of wave form, controlled sparking rate); uniform gas distribution; theoretical analysis of performance; theoretical efficiency; effects of resistivity; and effects of nonuniform gas velocity. Proportion, capacity, cleaning of electrical system, accessibility for maintenance, control of gas flow, control of erosion of dust from electrodes, and power supply are design factors that are critical elements in an electrostatic precipitator. The fundamental theory of the mechanisms involved in electrical precipitation is only partially understood at present. Designs are based either upon previous experience with similar processes or upon the results of pilot model precipitator studies. Data is tabulated on; dielectric constants for some common materials; pioneer precipitator installations (1907-1920); summary of U.S. precipitator installations in major fields of application; typical precipitator applications (flow rate, temperature, dust concentration, dust weight, efficiency, cost); suspended particulate matter in commercial gases in typical installations; average diameter of particles in various industrial operations; typical values of drift velocity encountered in practice for use with precipitators; and typical values for some design variables used in commercial electrostatic precipitator practices.

098[illegible]

Walsh, Robert T.

BOILERS, HEATERS, AND STEAM GENERATORS. In: Air Pollution Engineering Manual. (Air Pollution Control Dis- trict, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Cen- ter for Air Pollution Control, PHS-Pub-999-AP-40, p. 525- 558, 1967. GPO: 806-614-40

Boilers, heaters, and steam plants which burn fossil fuels (oil or gas) produce large quantities of particulates oxides of sulfur and nitrogen, and acid mist due to hydrolysis of SO3. Particulate emission during normal operation and tube cleaning is discussed. The formation, reactions, kinetics, and equilibria for NOx and SOx are presented which form the basis for recommendation on firebox temperatures, combustion oxygen concentrations, and burner design for optimum performance. Pollution control equipment, such as cyclones, filters, electrical precipitators, alkaline additives, metal oxide and carbon filled adsorbers, afterburners, and various scrubbers are described and evaluated. Experimental data is given for several methods of control. Lowering excess air, catalytic decomposition of NOx, reducing flame temperatures, and eliminating air preheat are also discussed. Consideration is given to the economics of emission control, especially SOx, and to thermal efficiency.

09904

Shafer, H. E., Jr., C. F. Cockrell, and J. W. Leonard

PROGRESS REPORT: FLYASH BRICK. Preprint, West Virginia Univ., Morgantown, School of Mines, ((14))p., 1966. (Presented at National Coal Association Technical-Sales Conference and Bituminous Coal Research, Inc., Annual Research, Inc., Annual Meeting, Pittsubrgh, Pa., Sept. 14-15, Meeting, Pittsburgh, Pa., Sept. 14-15, 1966.)

The disposal problem of flyash is most acute in large metropolitan areas. A process has been developed making a dry-pressed flyash based brick, as well as block, tile, and pipe, which can utilize large tonnages of ash without regard to physical and chemical properties. Tests demonstrated it was impractical to consider a 100 percent flyash product. Experiments demonstrated that 72 percent flyash combined with 25 percent coaser aggregate of ash or slag and 3 percent sodium silicate binder gave the most satisfactory product.

09905

Somers, E. V., J. R. Hamm, and N. E. Weeks

COAL-FIRED TURBINES. Preprint, Westinghouse Electric Corp., ((18)) p., 1966. 17 refs. (Presented at National Coal Association Technical -Sales Conference and Bituminous Coal Research, Inc., Annual Meeting, Pittsburgh, Pa., Sept. 14-15, 1966.)

Gasification of low grade coal followed by H2S removal provide a source of cheap fuel for gas turbine power plants. Turbine exhaust can be used directly in waste heat boilers, or because the oxygen content in the exhaust is high, the exhaust waste heat may be supplemented by burning more fuel. Economic and design details of such a power plant are presented. The advantages of such a plant are reduction of SO2 emission by 90 percent, reduction in thermal pollution of water by 60 percent, and use of cheap or low grade coals.

09923

HOW MUCH DUST IS IN FLUE GAS? Power, 111(5):86-87, May 1967.

New stack-emission limits increase the importance of dust collectors, but estimating dust content has been difficult. The report of a statistical study is presented which shows a correlation between particulate emissions and the ash content of the coal burned. Data on emissions from steam plants were submitted. The concentration at the steam generator outlet was measured. Size distributions were given also. The major variables were: particulate emission, size distribution and ash content. The survey focused on three types of coal-fired steam generators: pulverized coal; cyclone furnace and stoker fired. The results are presented.

09971

Dempsey, J. F.

REMOVAL OF SO2 FROM FLUE GAS. (LCD) (FINAL REPORT). AVCO Space Systems Div., Wilmington, Mass., Advanced Chemical Processes Section, Contract PH-86-67-51, AVSSD-0411-67-RB, 152 &., Nov. 1, 1967.

Processes for the removal of SO2 from power plant flue gases were studied. Process models were developed for fluid bed and transport reactor gas-solid contacting. Using the process models, the economics of the two types of processes, dispersed and fluid bed, compared, and operating and capital costs estimated. Also, the kinetics of the sorption process were measured and found to be pore diffusion controlled over most of the possible range of sorbent loadings A rate model describing the sorption process was developed. The rates of regeneration of spent sorbent were also measured. The kinetic data were used as inputs to the process models described above. (Author s abstract, modified)

09996

Corey, Richard C.

AIR POLLUTION RESEARCH IN RELATION TO COAL'S FUTURE IN THE ELEC- TRIC ENERGY MARKET. Combustion, 39(10):21-29, April 1968. 16 refs. (Presented at the 75th Anniversary Meeting, Illinois Mining Institute, Oct. 1967.)

The role of the Bureau of Mines in the air pollution field is that of an agency concerned with the most effective utilization of natural resources. A projection of the energy requirements of the nation indicates that coal will continue to be an important factor in the rapidly growing electric market. Six important possiblities for reducing sulfur emissions from coal fired electric utility systems include: unconventional electric power cycles; remotely located nine-mouth power plants; tall stacks; desulfurization before combustion; addition of compounds that absorb or react with SO2 in the combustion or post combustion regions in the boiler; removal of SO2 from flue gases before they are discharged to the stack.

09999

Reid, William T.

SULFUR OXIDES CONTROL IN CENTRAL STATION POWER PLANTS. Heating, Piping, Air Conditioning, 40(3):148-154, March 1968. 11 refs. 1968. 11 refs.

Stringent restrictions on the amount of pollutant allowed to reach the atmosphere are leading to critical assessments of methods of SO2 control. Three methods are available to decrease the amount of SO2 in flue gas: burn a low sulfur fuel, desulfurize available fuels, or remove sulfur oxides from flue gas. Supplies of low sulfur fuels are limited and economics have made desulfurize of fuels unattractive, therefore the removal of SO2 from flue gas is investigated. Flow diagrams for eight systems are presented and their advantages and disadvantages are compared.

10003

Strauss, W. and B. W. Lancaster

PREDICTION OF EFFECTIVENESS OF GAS CLEANING METHODS AT HIGH TEMPERATURES AND PRESSURES. Atmos. Environ., 22):135-144, March 1968. 16 refs.

In the design of clean up systems for advanced power generation systems it is necessary to know the effects of extreme temperatures and pressures on the fundamental collection mechanisms involved in gas cleaning processes. By calculating the effects of elevated temperature and pressure on the parameters involved in gas cleaning processes it is predicted that the collection efficiencies of all processes will be reduced under these conditions. The most promisi mechanism at high temperature and pressure appears to be electrostatic precipitation.

10165

Zakieva, S. K., and A. B. Taubman

WETTING AGENTS PROPERTY TO CATCH DUST IN A DUST CHAMBER. Zh. Prikl. Khim, 32(4):898-800, 1959. 8 refs. Translated from Russian by B. S. Levine, U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 6, 299p., April 1961. CFSTI: TT 61-21982

A special method was developed based on the use of a laboratory dust chamber for the evaluation of dust catching capacity of wetting agent solutions with a lower surface tension, particularly in their application to the abatement of deleterious silicon and anthracite dusts. The value of a new synthethic wetting agent known as RAS-Na in catching silicosis and anthracosis producing dusts has been established by this method.

10264

Senyushkin, N. I.

INCREASING THE EFFICIENCY OF SCRUBBERS. ((Povyshenie effektivnosti raboty skrubberov.)) Text in Russian. Energetik (Moscow), 15(6):15-17, June 1967.

In a thermal power plant using Bashkir coal, four scrubbers MP-VTI (2600 mm. diameter) were installed in 1965 for the removal of fly ash. However, several shortcomings in the design of the scrubber made their operation unreliable. To prevent clogging of gas passages with fly ash, several stationary nozzles were installed for flushing the ash from the walls of the gas ducts and for the wetting of retention grids. PRIOR TO THESE MODIFICATIONS, THE PRESSURE DROP INCREASED considerably after 96 hours of operation, but after the modification the pressure drop increased 50 mm. of water column after 1440 hours of operation. The original four rows of grids were replaced by two rows of gravel-bakelite grids. The hydraulic seals and equipment for sprinkling the scrubber walls were also modified. This modified scrubber has a water consumption of 46 t./hr. and an efficiency of 92.5%.

10281

SULPHUR: THE ECONOMICS OF NEW RECOVERY SYSTEMS. Eng. Mining J., 169(5):63-72, May 1968.

Since the turn of the century, low cost Frasch production has supplied much of the world's sulfur. Beginning in 1963, demand outstripped production and consumption was met by drawing from inventory. In 1967, sulfur stocks were at an irreducible minimum and consumers had to exist on hand-to-mouth allocations from the major producers. Foreseeing the tight supply, major producers have spent between $30 and 50 million over a period of a decade to find new reserves without major success. By-product S has therefore become an important feature of the research programs for coal-to-synthetic fuels. Three of these processes are reviewed.

10336

Sebastiani, Enzo

ELIMINATION OF NITROGEN OXIDES. ((L'eliminazione degli ossidi di azoto.)) Text in Italian. Securitas (Rome), 51(5):31-44, May 1966. 23 refs.

Some processing for eliminating nitrogen oxides (NO and NO2) from industrial flue gases are described. There are absorption processes in alkaline solutions, possibly in the presence of oxidizing agents absorption processes based on the use of solid materials with high superficial development; catalytic reducing processes to elementary nitrogen or ammonia using palladium, platinum, rhodium or other similarly based catalysts working under pressure at a high temperature. As such processes present difficulties from the technical and economic standpoints when put into practice, the author expresses the hope that the problem will continue to be studied for the purpose of finding other simpler and more effective processes.

10399

J. H. N. Jelgersma

LOW-TEMPERATURE CORROSION AND FOULING OF OIL-FIRED BOILERS. (Corrosie en vervuiling bij lage temperatuur in met olie gestookte ketels.) Text in Dutch. Electro-Techniek (The Hague), 43(16):359-363, Aug. 12, 1965. 5 refs.

Difficulties encountered with firing heavy fuel oil in steam power plants are discussed (low-temperature corrosion, fouling, and acid smut emission). These phenomena are caused by condensation of sulfuric acid from flue gases onto boiler surfaces with temperatures below the acid dewpoint. Formation of SO3, condensation of sulfuric acid, and means to prevent or reduce either of these processes are discussed, with particular attention to the oxygen fuel micture in combustion, regulation of SO2 in exhaust gas by monitoring the O2 content, the use of binding agents (particulate matter, chemicals) to remove SO3 from exhaust gases, and the use of heat exchangers to keep flue gas temperature above the acid dewpoint. In order to provide sufficient ventilation and turbulence during firing, cylinder-shaped combustion sleeves and a high air velocity are used.

10493

Copeland, John O.

KILOWATTS AND CLEAN AIR. Preprint, Public Health Service, Durham, N. C., National Center for Air Pollution Control, 21p., May 1968.

The air pollution problem is described as one of emissions, effects, regulation, and control touching the technical, political, social, and economic aspects of our society. U. S. Public Health Service 1966 estimates of 142 million tons of pollutant emissions p annum are reported by type and source with predictions for rapid increases unless air pollution is controlled in the near future. A quality criteria are stressed as necessary guidelines for control, and published acceptable air quality for sulfur oxides is compared with levels in more than 20 cities where sulfur oxides air quality has exceeded acceptable limits. Authority for control is described as lying with many jurisdictions, with the trend toward centralization to cover every locality within the United States. T Federal role in air pollution control is discussed. Control of smoke, particulate, and sulfur and nitrogen oxides is covered with respect to control capabilities; special emphasis is placed upon various alternatives available for sulfur oxides control. (Author' abstract)

10563

Miyajima, M.

AIR POLLUTION CONTROL MEASURES TAKEN AT THE POWER STATIONS IN YOKKAICHI DISTRICT. Text in Japanese. Nenryo Kyokaishi 45(474):731-736, 1966. 3 refs.

The number of complaints about fumes, poisonous gas, odor, fly ash, etc., due to Yokkaichi power stations increased almost tenfold between 1961 and 1965. While the volume of pollutant gases emitted from these sources is large, their deleterious effect is small, due to the means of dispersal employed, such as accelerated speed of emission, increases in smoke temperature and intermittent, or batch, release of smoke. In particular, the subject of stack height and effective stack structure is discussed. Another approach being utilized is experimentation with the DAP-Mn (dry) process of SO2 absorption which has been investigated in five experiments on a pilot plant scale. A flow-chart of the process is shown.

10591

Grigoryan, G. O. and R. M. Ki[illegible]osyan

PREPARATION OF AMMONIUM SULFATE FROM LOW CONCENTRATIONS OF SULFUROUS GASES BY OXIDATION OF SO3 IN THE LIQUID PHASE USING ATMOSPHERIC OXYGEN IN THE PRESENCE OF NITROGEN OXIDES, USED AS INITIATORS. (Poluchenie sul'fata ammoniya iz nizkokotsentrirovannykh sernistykh gazov okisleniem SO3 - iona v zhidkoi faze kislorodom vozdukha v prisutstvii okislov azota, kak initsiatora.) Text in Russian. Army. Khim. Zh.(Erevan), 20(2):164-169, 1967. 10 refs.

Test results are detailed for an experimental installation where SO3 is oxidized into SO4 using atmospheric oxygen in the presence of nitrogen oxides as initiators. The method is a continuous technological process (with recovery of absorbents and filtrates) for the utilization of weak sulfurous gases and yields ammonium sulfate and multicomponent fertilizers. The technological procedure is flow charted. The procedure starts with a mixture of air and 0.6 1.0% sulfurous anhydride, to be passed through a suspension of magnesium hydroxide. The resulting suspension is then oxidized by atmospheric oxygen, containing 0.002% nitrogen oxides. An almost complete oxidation of magnesium sulfite into magnesium sulfate takes place in the reactor at 40 Degrees C. The yield, magnesium sulfate, reacts with ammonia at 60 Degrees C. and pH 7. Magnesium hydroxide is then returned into the production cycle and the filtrate, containing ammonium sulfate and Schoenite, reduced to 1/3 of its volume by evaporation, is cooled to 15 Degrees C. The Schoenite crystals are then removed (and returned to the production cycle) and the ammonium sulfate solution evaporated and crystallized. Results show that 36.9% of the total ammonium sulfate returns to the production cycle with the magnesium hydroxide, with 20.8% remaining in the cycle as a Schoenite component, while 45.2% is extracted as end product.

10655

Crawford, W. D.

THE COST OF CLEAN ENERGY. Preprint, Consolidated Edison Co. of New York, Inc., 14p., 1968. (Presented at the

61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-3.)

The economic aspects of air pollution control from the electric utility viewpoint are described. Municipal and state regulations limiting the allowable sulfur content of fossil fuels are having the effect of changing fuel use patterns of many of the nation's utilities. The utility companies are faced with increased costs of lower sulfur fuels and capital expenditures associated with the fuel changes, as well as with greater uncertainty concerning long term supplies of suitable fuels. Capital costs for air pollution control are mounting. Electrostatic precipitators must be built to meet more stringent air pollution codes, and stack heights may have to be increased to improve discharge patterns. It is primarily the economic aspect of the removal of sulfur from coal which has kept that art in the research and development stage. No financially attractive method of removal, either before or after combustion, has been completely tested and proven to date. Nuclear power is the long range solution to which many utilities look but, in the shorter view, the power industry must expect continued cost increases in the areas of fuel and operating expenses, capital expenditures and research and development.

10680

Martin, G. Blair and John H. Wasser, Jr.

PROPRIETARY ADDITIVES AVAILABLE FOR USE IN FUELS. (LISTING.) Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 18 p., 1968.

A compilation of fuels and fuel additives was made to evaluate the effects of fuel additives on air pollution emissions. The listing includes the manufacturer of the additive, the additive, fuel type, additive dose, specific function of additive, and a description of the additive. 10680 Martin, G. Blair and John H. Wasser, Jr. PROPRIETARY ADDITIVES AVAILABLE FOR USE IN FUELS. (LISTING.) Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 18 p., 1968. CONTROL METHODS: Fuel additives A compilation of fuels and fuel additives was made to evaluate the effects of fuel additives on air pollution emissions. The listing includes the manufacturer of the additive, the additive, fuel type, additive dose, specific function of additive, and a description of the additive.

10681

Tennessee Valley Authority

SULFUR OXIDE REMOVAL FROM POWER PLANT STACK GAS: CONCEPTUAL DESIGN AND COST STUDY.SORPTION BY LIMESTONE OR LIME:DRY PROCESS. 91p., 1968. 57 refs. CFSTI: PB-178971

The dry limestone process for the removal of sulfur oxides from power plant stack gases is of interest because of the low invest ment involved. A complete study of the design and cost of a dry lime or limestone injection system is presented. The following topics are thoroughly discussed: the present status of dry lime stone sorption, study assumptions and design criteria, process equipment, effects of limestone injection on power plant operation, economic evaluation, research and development needed, limestone sorption studies, limestone availability and technology, experi mental work supplementing the design study, and cost estimates for the process.

10692

Kiyoura, Raisaku

STUDIES ON THE REMOVAL OF SULPHUR DIOXIDE FROM HOT FLUE GASES AS A MEASURE TO PREVENT AIR POLLUTION. III. EFFECT OF FLUE DUST ON THE VANADIUM OXIDE CATALYST UTILIZE BY THE CONTACT OXIDATION PROCESS. Preprint, Tokyo Inst. of Tech. (Japan), 11p., 1968. 19 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-182.)

The Kiyoura-T.I.T. (contact) process deals with the desulphurization of flue gas. It employs vanadium pentoxide as a catalyst which oxidizes the sulfur dioxide to trioxide, followed by a gaseous phase reaction with ammonia. The end product, ammonium sulfate, is removed by an electrostatic precipitator. Experiments were conducted to determine if dust in flue gas had any effect on the activity of the catalyst. The results showed that at the actual operational temperature of 450 Degrees C, ash had practically no effect on the catalyst at all.

10704

Shale, C. C.

ASH ACCUMULLATION ON PRECIPITATOR DISCHARGE WIRES. Preprint, Bureau of Mines, Morgantown, W. Va., Morgantown Coal Re- search Center, 12p., 1968. 13 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-102.)

Factors from existing precipitator theory and field experience on industrial precipitators are used in conjunction with interpreta tions from basic corona studies to analyze the cause for deposition of particles on the high-tension electrodes in an electrostatic precipitator. A revised theory is presented. The role of gas turbulence (produced by the electric wind) in causing deposition on the wires, and the effects of highly resistive ash after deposi tion, are reviewed. (Author's abstract)

10770

Taylor, W. G., F. F. Davis, Jr., S. M. DeCorso, C. E. Hussey, and M. J. Ambrose

REDUCING SMOKE FROM GAS TURBINES. Mech. Eng., 90(7):29-35, July 1968.

The increase in the use of gas-turbine package power plants for peaking has resulted in an increase in the use of distillate oil. The size of smoke particles emitted by gas turbine burning distil late oil is such that although they are highly visible, they are difficult to entrap. Control can be achieved by the use of the either fuel additives or burner-combustor modification. In view of the increasing stringency of regulations on smoke emission, it is essential that the physical laws governing smoke visibility be more widely understood. Some of these physical laws have been discussed briefly.

40933T

E. Schaufler, K. H. Oehrlich K. R. Schmidt

THE CENTRIFUGAL DUST SEPARATOR. Translated from German. Staub 23(4):228-230, Apr. 1963. 1 ref.

The principle of a newly developed dust separator is explained. The operation of the separator is based on a vortex generated by countercurrent gas injection into the raw gas moving upwards in a vertical tube. To reinforce the separating effect a drop shaped bluff body is placed in the tube. Separation efficiencies for different particle size fractions were determined in a 200 mm diameter separator. Tests with larger units (300-1000 mm diameter) have been also conducted. The installation of a separator into the smoke stack of a power plant (2-2.5 m in diameter) is being planned.

10968

Anon.

POLLUTION CONTROL-AND BY-PRODUCT SULPHUR TOO. PART 2. Eng. Mining J., 169(6):91-100, June 1968.

The amounts of volatile matter, ash, and sulfur, and the heating value are the most important characteristics of fuel. The sources of SO2 in the air are discussed. Four important processes which are used for removing S from stack gases are: the alkalized alumina process, the catalytic oxidation process, the activated char process, and the dolomite injection process. Flow sheets and some cost data are presented for these systems. Work being done on removal of pollutants from coal before burning are discussed. The S levels of coal reserves in the U. S., which are tabulated by state, show 70% with less than 1.6% S.

10993

Opladen, H. B.

COMPUTER-OPTIMIZED FIRE REDUCES AIR POLLUTION. Instrum. Technol., 15(8):63-66, Aug. 1968.

Increasing emphasis on air pollution control dictates that any new oil-fired plants include methods for reducing pollutants to permissible levels. The inherent computational and logical capabilities of digital computers can be applied to optimize combustion in oil-fired steam power plant. The computer can find the necessary percentage of excess air to minimize carbon monozide without sinsible heat loss. It can also determine the best pressure for atomizing fuel oils, achieving an oil droplet size that gives maximum burnout and reduces smoke emission.

11005

Schwarz, O.

RECENT RESEARCH AND DEVELOPMENT WORK ON COAL UTILISATION IN THERMAL POWER STATIONS. UPGRADING AND UTILISATION OF FLY ASH AND SLAG. Mitt. Ver. Grosskesselbesitzer, 1967 (109):250-261, Aug. 1967. Translated from German in Brit. Coal Util. Res. Assoc. Monthly Bull., 32(6):145-151, June 1968.

With developments in power station technology, the handling of slag and fly ash is undergoing a change. An experimental sintering plant for study of the effect of sintering on utilization and recirculation of fly ash is described.

11055

H. Juntgen, W. Peters

RESULTS OF RECENT RESEARCH IN WASTE GAS DESULFURIZATION. Staub (English translation), 28(3):1-6, March 1968. 13 refs. CFSTI: TT 68-50448/3

The development is reported for an imporoved method for binding SO2 present in flue gas from hard coal firing, which is tested at present on a semi-industrial scale. Investigations into the physico-chemical basis of the reaction of alkaline earth compounds with SO2 are described. In the case of injected CaCO3 and CaO powders, at a temperature of 800 degrees C, and SO2 concentration of 1,200 ppm and with stoichiometric proportioning, a maximum conversion of 50% can only be obtained in a semi-industrial experimental installation. The reaction kinetics under non-isothermic conditions have been investigated in a laboratory for the purpose of improving the utilization of powders used as desulphurizers. (Authors' summary, modified)

11131

Sappok, R. J.and P. L. Walker, Jr.

REMOVAL OF SO2 FROM FLUE GASES USING CARBON AT ELEVATED TEMPERATURES. Preprint, Pennsylvania State Univ., Univer- sity Park, Dept. of Materials Science, (26)p., (1968).

The interaction of a typical flue gas with active charcoal and bituminous coal char at temperatures between 600-800 deg. C and atmospheric pressure has been studied. The SO2 in the flue gas sulfur surface complex. H2S and COS break through the carbon b interacts with the carbon to form primarily H2S, COS, and a car bon sulfur surface complex. H2S and COS break through the car bon bed much in advance of SO2. At 800 deg. C, sulfur retention on the bed exceeds at least 11 weight % before SO2 break-through occurs. The reaction of H2S and COS with 02 over active char coal at 100-140 deg. C to produce sulfur, which deposits on the carbon, has also been studied and found to be feasible. As a result of this study, a new process is outlined for the removal of SO2 from flue gas, with the ultimate conversion of the SO2 to elemental sulfur. (Authors' abstract)

11159

J. F. McLaughlin, Jr.

PROGRESS IN MEETING POWER PLANT AIR POLLUTION PROBLEMS. EEI Bull. 36 (5), 155-9 (May 1968).

The most difficult air pollution problem for power plants today is sulfur dioxide. The British approach to the problem is to support a tall stack policy for the control of emissions from power plants. Four major sulfur dioxide control processes under development in the United States are discussed. These are the Combustion Engineering alkaline additive process, the Monsanto catalytic gas-phase oxidation process, the Bureau of Mines alkalized alumina process, and the Wellman Lord chemical absorption process. A research program is being conducted to de termine the maximum concentration of SO2 that is compatible with good health. 36(5):155-159, May 1968. EMISSION SOURCES, CONTROL METHODS: Power production, Sulfur dioxide, Stacks The most difficult air pollution problem for power plants today is sulfur dioxide. The British approach to the problem is to support a tall stack policy for the control of emissions from power plants. Four major sulfur dioxide control processes under development in the United States are discussed. These are the Combustion En gineering alkaline additive process, the Monsanto catalytic gas phase oxidation process, the Bureau of Mines alkalized alumina process, and the Wellman Lord Chemical absorption process. A research program is being conducted to determine the maximum concen tration of SO2 that is compatible with good health.

11178

A.K. Jain, P.M. Chen, J.W. Bishop, E.B. Robinson, and S. Ehrlich

STATUS OF THE DIRECT HEAT TRANSFERRING FLUIDIZED BED BOILER. Preprint, American Society of Mechanical Engineers, New York, 12p., 1968. 4 refs. (Presented at the ASME Annual Meeting and Energy System Exposition, New York, N. Y. Dec. 1-5, 1968, Paper 68-WA/FU-J.)

The recent fluidized bed boiler development work sponsored by the Office of Coal Research and the Department of Interior is des cribed. Basically the system involves replacement of the con ventional boiler furnace with fluidized suspension of intert ma terial into which coal is injected and burned. High-heat releases and heat transfer direct from bed material to heating surface obtained by this process reult in very high steaming capacities from an exceptionally small boiler. From experimental data derived in operation of a full-scale single-module boiler, packaged railroad transportable units can be built up to 300,000 lb/hr capacity or larger. The envisioned utility boilers of 2,000,000 lb/hr and greater represent about 15 percent of the overall size of a similar capacity pulverized coal unit. Envisioned large cost savings should make coal more competitive as a boiler fuel. The use of limestone for sulfur-oxide abatement in this system is far more effective than the open furnaces or gas passes of conventional boilers. SO2 reductions of 65 percent have already been accomplished and greater reductions are anticipated. (Authors' abstract)

11191

Feldman, H. F., W. H. Simons, J. Sax and D. Bienstock

OPERATING COAL-FIRED, OPEN-CYCLE MHD SYSTEMS AT LOW AIR/FUEL RATIOS. Preprint, American Society of Mechanical Engineers, New York, N. Y., 9p. 1968. 8 refs. (Presented at the ASME Annual Meeting and Energy Systems Exposition, New York, N. Y., Dec. 1-5, 1968, Paper 68-WA/ENER-15.)

Techniques for increasing the electrical conductivity of combus- tion products from ash containing coals and char by operating the MHD generator at air/fuel ratios below stoichiumetric and by using a nonsulfur seed are investigated. In the low air/fuel ratio schemes, additional combustion air is injected downstream from the slag separator to increase the overall plant thermal efficiency and to eliminate carbon monoxide from the effluent gas. Data are presented for 0.5 and 4 weight-percent sulfur bituminous coals and a bituminous coal char seeded with K2CO3 and K2SO4. This study shows that operation of the MHD generator at below stoichiometric air/fuel ratios results in a substantial increase in the electrical conductivity of the combustion products and with it the potential of lowering magnet and capital costs at the expense of some thermal efficiency. The greatest increase in electrical conductivity with nonsulfur containing seed is achieved using low sulfur (0.5 weight-percent) coal or bituminous coal char. For high-sulfur (4 weight-percent) fuels, no significant change in electrical conductivity can be attributed to varying sulfur levels of the seed. (Authors' abstract)

11215

Saltsman, R. D.

THE REMOVAL OF PYRITE FROM COAL. Preprint, American Society of Mechanical Engineers, New York, 8p., 1968. 7 refs. (Presented at the American Society of Mechanical Engineers Winter Annual Meeting and Energy Systems Exposition, New York, Dec. 1-5, 1968, Paper 68-WA/FU-2.)

The occurrence of pyrite in coal is discussed and a brief review is made of previous work at Bituminous Coal Research, Inc., on pyrite removal that led to two substantial projects. The first of these projects, cosponsored with 12 Eastern utilities, is a program to evaluate methods for optimizing pyrite removal from the pulverizing mill prior to combustion. The second project is sponsored by the U.S. Public Health Service and is an evaluation of coal cleaning methods and techniques for removal of pyritic sulfur from fine coal. The sulfur contents and degrees of pyrite removal for 44 industrial coals are discussed and presented. (Author's abstract, modified)

11229

W. S. Landers

TRENDS IN STEAM STATION DESIGN AFFECTING AIR POLLUTION. Preprint, American Society of Mechanical Engineers, New York 4p., 1966. 8 refs. (Presented at the IEEE-ASME Joint Power Generation Conference, Denver, Colo., Sept. 18-21, 1966, Paper 66-PWR-1.)

The design, location, and operation of coal-burning thermal electric plants encompass various elements affecting air pollution, such as plant size and location, stack height, coal used, ash collecting and handling systems. Trends have developed in some of these elements as a result of the various factors governing management decisions on expansion of generating capacity. This paper identifies these trends by an analysis of 150 coal-burning thermal power units scheduled for initial operation from 1958 through 1968. (Author's abstract)

11233

J. G. Stites, Jr., W. R. Horlacher, Jr., J. L. C. Bachofer, Jr., and J. S. Bartman

THE CATALYTIC-OXIDATION SYSTEM FOR REMOVING SO2 FROM FLUE GAS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1968. (Presented at the American Society of Mechanical Engineers Winter Annual Meeting and Energy Systems Exposition, New York, N. Y., Dec. 1-5, 1968, Paper 68-WA/APC-2.)

The demonstration of a prototype plant to remove sulfur dioxide from flue gas by catalytic oxidation is discussed. The plant has a capacity of 24,000 scfm. It was designed to remove essentially 100 percent of the particulates from the flue gas.About 90 percent of the sulfur dioxide is oxidized to sulfur trioxide and removed as 80 percent sulfuric acid. Recovery and sale of the sulfuric acid from large coal and oil fired power stations can offset a substantial portion of the cost of the recovery system. This paper deals with operating experience with the prototype plant and projected costs of commercial units. (Authors' abstract, modified)

11238

R. R. Dukes, and M. D. Farkas

SULFUR SHORTAGE VS PLANT DESIGN. Preprint, Leonard Construction Co., Chicago, Ill., 25p., 1968. 5 refs. (Presented at the 61st Annual Meeting, American Institute of Chemical Engineers, Symposium on Sulfur, Sulfuric Acid and the Future, Part I, Los Angeles, Calif., Dec. 1-5, 1968, Paper 5-C.)

Sulfuric acid plants can be built using SO2 bearing gases from various sources. The most important characteristic from the viewpoint of economics is the SO2 concentrations. Catalyst poisons such as fluorides should be avoided, and the SO3 and particulate contents should be as low as possible. If the SO2 content is low, the operating costs will be high because of increased utility requirements as fuel to keep the plant in thermal balance, and a power to supply refrigerated water. The amortization costs will be high because of the increased capital requirements. (Authors' summary)

11240

H. L. Falkenberry, and A. V. Slack

REMOVAL OF SO2 FROM POWER PLANT STACK GASES BY LIMESTONE INJECTION. Preprint, Tennessee Valley Authority, Chattanooga,((35))p., 1968. ((8))refs. (Presented at the 61st Annual Meeting, American Institute of Chemical Engineers, Symposium on Chemical Reaction Engineering, Part II, Los Angeles, Calif., Dec. 1-5, 1968, Paper 54b.)

A review of limestone injection into power boilers as a means for removing sulfur oxides from stack gases is given. This includes a conceptual design and cost study, basic research on limestone reactivity, and full-scale testing in a power plant.

11247

Jack E. Newell

SULPHUR FROM FLUE GASES A PROCESS EVALUATION USING ABSORPTION ON ALKALISED ALUMINA. Preprint, Central Electricity Generating Board, London (England), 17p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Prototype Research and Development of Sulfur Pollution Control Processes, Los Angeles, Calif., Dec. 1-5, 1968, Paper 54d.)

The alkalised alumina process, has been developed in Britain using fluidised bed reactors rather than the dispersed phase system favoured by the original American authors. The functional emphasis for the process in Britain also differs in that commercial recovery of sulphur is the primary objective, air pollution control being secondary. Thus, the design aims at low capital investment and economic commercial operation, rather than at high gas cleanup efficiency, the plant recovering sulphur at an almost constant rate regardless of actual sulphur input and operating 24 hours per day even when the associated boiler plant shuts down overnight. This has necessitated a new regeneration system and a different approach to thermal economy from that described in the author's earlier paper which aimed at high cleanup efficiency and full thermal integration with the power station heat cycle. In addition to discussing the design of process plant, the paper presents costing and economic evaluation. It also shows the suitability of the plant for use at large industrial sites other than power stations. (Author's abstract)

11250

C. F. Scheidel

SULPHUR DIOXIDE REMOVAL FROM TAIL GAS BY THE SULFACID PROCESS. Preprint, Lurgi Apparatebau Gesellschaft mbh, Frankfurt (Germany), ((25))p., 1968. (Presented ath the 61st Annual Meeting, Symposium on Sulfur, Sulfuric Acid and the Future, Part II, Los Angeles, Calif., Dec. 1-5, 1968, Paper 6 E.)

A sulfur dioxide removal process is described. Gases containing SO2 are passed through an activated carbon reactor and optimum removal of SO2 is reached if the gas is saturated with water at a temperature of approximately 160 degree F. The bed of activated carbon is sprayed with water. The following process steps are required for wet catalytic conversion to sulfuric acid: 1) adsorption of SO2 milecules 2) oxidation of SO2 3) removal of SO3 by flushing with water 4) increase of solubility of SO2 with lower sulfuric acid concentration in liquid film 5) the rate of H2SO4 adsorption increases with H2SO4 concentration which slows down SO2 diffusion in adsorbent. A description of the chemical plant and equipment used in this process is given along with operating costs.

11251

Smith, M. C. and A. A. Salerno

ENGINEERING FOR LOW SULFUR FUELS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1968. (Presented at the ASME Annual and Energy Systems Exposition, New York, N.Y., Dec. 1-5, 1968, Paper 68-WA/APC-1.)

Engineering for low-sulfur fuels must recognize several things. Electrostatic precipitators on low-sulfur coal have lowered efficiencies. The difficulty of obtaining low fusion point coal with low-sulfur content for use in wet bottom boilers may force conversion away from this type of boiler. Low-sulfur oil may very well have a high pour point which makes heating of fuel lines necessary. Viscosity limits are necessary to be assured that existing system fuel oil pumps can continue to be used.

11252

Uno, Tsukumo, Saburo Fukui, Masumi Atsukawa. Masao Higashi, Hiroshi Yamada, and Kazumi Kamei

SCALE-UP OF DAP-MN SULFUR OXIDE CONTROL PROCESS. Preprint, Mitsubishi Heavy Industries, Ltd., Tokyo (Japan), 12p., 1968. (Presented at the 61st Annual Meeting, Symposium on Prototype Research and Development of Sulfur Pollution Control Process, Los Angeles, Calif., Dec. 1-5, 1968, Paper 54C.)

A semicommercial plant treating 150,000 Ncum/hr of flue gas for sulfur oxides removal is now running on at Yokkaichi power station in Japan. This plant removes sulfur oxides by the DAP-Mn process which uses activated manganese oxide as absorbent and recover ammonium sulphate as byproduct. This paper deals with scale-up problems of the process based on the data obtained in bench scale apparatus, pilot plant and semicommercial plant. Most important part of the process concerning scale-up are fluidized bed type of absorber and bubbling tower type of oxidizer. We have found that each of them may be designed based on a reaction rate equation respectively without relation to plant scales if operating conditions of them are not so different with that of semicommercial plant. (Authors' abstract)

11253

MONSANTO PROCESS REMOVES SULFUR DIOXIDE FROM GASES. Edison Elec. Inst. Bull., 36(9):320, Oct. 1968.

Successful operation of a prototype plant to remove sulfur dioxide from the stack gases of a coal-fired boiler has been announced. The prototype unit, a catalytic oxidation process called the Cat-Ox system, removes sulfur dioxide, as well as fly ash, from the flue gases of a power generating station. The process involves taking hot (900 F) flue gases directly from the boiler and passing them first through a hot electrostatic precipitator to remove fly ash. This precipitator removes excess of 99.5 percent of the solids from the gas stream. The gases are then passed through a converter where the sulfur dioxide is catalytically oxidized to sulfur trioxide. From the converter the gases are passed through a series of heat exchangers to recover heat, which is sent back to the boiler cycle. The heat exchangers cool the gases so that the sulfur trioxide and the water vapor present in the flue gases combine, but at a temperature still above the dew point of sulfuric acid. The gases further cooled in an absorbing tower, which condenses the sulfuric acid. Some of the acid is produced a mist, which is collected and removed from the system by a highly efficient mist eliminator. The sulfuric acid is collected and sent to storage.

11256

SO2 REMOVED FROM FLUE GASES. Oil and Gas J., 66(46):102, Nov. 11, 1968.

A system now available promises a solution to sulfur dioxide emission problems in flue gases of boilers. Called the Cat-Ox system, it is a catalytic oxidation process. The process involves taking hot flue gases from a boiler and passing them first through a hot electrostatic precipitator then through a converter where sulfur dioxide is catalytically oxidized to sulfur trioxide. From the converter the gases pass through a high-level economizer and an air preheater to recover heat which is sent back to the boiler cycle.

11262

Williamson, Gerald V. and John F. McLaughlin

AIR POLLUTION, ITS RELATION TO THE EXPANDING POWER INDUSTRY. Union Electric Co., St. Louis, Mo., 16p., 1966. 6 refs. (Presented at the World Power Conference, Tokyo Sectional Meeting, Tokyo, Oct. 16-20, 1966, Paper 89.)

Air pollution considerations will be a major factor in the expanding power industry. Micro-meteorological evidence indicates that new plants of 500 to 5,000 MW must be located and designed with a full understanding of the area's urban air standards, up to a distance of 25 miles from the site. With the development of high efficiency dust collectors, stress in the future will be on SO2 and other invisible gases. The balance of the paper amounts to a check-list of what the planner-designers might do, including choice of features of stack height, position of the stack in the heat cycle, and possible provisions during pollution emergencies. (Authors' summary, modified)

11281

Ionics, Inc., Watertown, Mass., Research Div (17)p. July 1966.

A BRIEF DESCRIPTION ON THE USE OF AN ELECTROLYTIC SULFATE CELL FOR THE RECOVERY OF SULFUR DIOXIDE FROM STACK GAS.

An Electrolytic Sulfate Cell is proposed for the removal of sulfur dioxide from stack gases. The sulfur dioxide can be recovered as a concentrated gaseous stream suitable for ultimate conversion to sulfuric acid. The main components of the Electrolytic Sulfate Cell are an anode, a diaphragm, a cation-transfer membrane and a cathode. The membrane cell readily produces 2N sodium hydroxide at the cathode and that the alkali concentration was easily controllable. Operating at current densities of 100 amps sq ft, 2N caustic was produced at the cathode and 1N acid at the anode. The operating temperature of the cell was 80 degrees C and the feed solution consisted of 10% sodium sulfate. Cell voltage requirements were approximately 5 volts and cell efficiencies were greater than 90%. Even lower voltage requirements were achieved in subsequent investigations. A schematic flow diagram of one possible integrated system is presented. Preliminary estimates are presented for the cost of recovering sulfuric acid from stack gases using an Electrolytic Sulfate Cell. Two cases were studied, one using New York City fuel oil with 0.8% S and the other coal with 3% S. Total investment is estimated at $4.00 and $11.00 per KW installed for oil and coal-fired stations respectively. Operating costs including depreciation at 5% are 0.13 and 0.42 mils per KWH generated respectively assuming energy at 6 mils per KWH. Under these conditions there will be an operating credit of 0.017 and 0.19 mils per KWH generated respectively.

11847

Zawadzki, Edward A.

STATUS OF THE DEVELOPMENT OF PROCESSES FOR CONTROLLING SO2 EMISSIONS FROM STATIONARY SOURCES. Preprint, National Limestone Inst., Inc., Washington, D. C., 15p., 1969. (Presented at the National Limestone Institute, Inc., 24th Annual Convention, Jan. 16, 1969.

The principle sources of sulfur dioxide emissions in the United States are utility plants and, to a lesser degree, industrial-size stationary combustion units and smelters. By 1980, the estimated amount of sulfur dioxide emitted to the atmosphere annually will increase to 50 million tons, double the current rate. Controlling the emissions is difficult, and only limited success has been achieved to date. The principle factors affecting the development of pollution control systems, especially for power plant utilities, are size of unit, age of unit, load factor, and geographic location. In spite of the difficulties associated with the processing of flue gases, a large number of processes have been developed. They fall into two main classes: sulfur recovery systems that produce a product, and nonrecovery systems that yield innocuous wastes. The process that appears most readily adapted to existing power stations of all sizes is the dry limestone injection process. The capital cost of the process for a 200-megawatt station ranges from 1.2 to 1.6 million dollars. Annual operating cost is about 0.4 to 0.5 million, with about 20-25% of the cost attributed to the cost of limestone. Most other SO2 control processes are not economically suited to 200-megawatt and smaller stations.

11854

Goldschmidt, Klaus

EXPERIMENTS IN THE USE OF WHITE LIME HYDRATE AND DOLOMITE LIME TO DESULFURIZE FLUE GASES FROM OIL-AND PULVERIZED COAL-FIRED FURNACES. (Versuche zur Entschwefelung von Rauchgasen mit Weisskalkhydrat und Dolomitkalkhydrat bei Oel-und Kohlenstaub-Feuerung). Fortschrittber. VDI(Ver. Deut. Ingr.) Z., Ser. 6(21), 133p., Aug. 1968. 47 refs. Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 138p.

The suitability of white lime hydrate and dolomite lime hydrate to desulfurize flue gases was tested by mixing the additives with pulverized coal by injecting them into the combustion chamber above the burner of a furnace heated with pulverized coal and oil. The experiments confirmed theoretical predictions that, due to the short residence time of flue gases and additives in a furnace, complete desulfurization is not feasible. Direct mixing of coal and additive caused formation of eutectic melts during combustion, leading to heavy caking of the furnace. Only small amounts of sulfur dioxide were bound by additive surfaces. A higher desulfurization rate was achieved by injecting the additive into the zone of the furnace where temperatures of about 1000 C prevailed. White lime hydrate was more satisfactory than dolomite lime hydrate, since the additive contains fewer impurities and the decomposition pressures of calcium sulfate are lower at constant temperature than those of magnesium sulfate. The best desulfurization results were obtained with oil-firing. Here, the additive depositions on the rear heating surfaces continue to bind S02 and are the major factors in the totally achieved desulfurization rate. Despite this, only 50% of the S02 was bound.

11906

Hilder, Wolfgang

A NEW SULPHURIC ACID INSTALLATION REDUCES SULPHER DIOXIDE EMISSION. ((Neue Schwefelsaureanlage verringert Schwefeldioxidemission.)) Text in German. Stadtehygiene, 19(6):125-127, June 1968.

An increased (24%) consumption of sulfuric acid (H2SO4) (used in the manufacture of fertilizers, vitamin pigments, artificial fibers, etc.) in the German Federated Republic over the last 5 years, a 78% H2S04 made in the Chamber and Tower Process which did not fulfill all purity requirements, and a shortage of elemental sulfur caused interest in the Pyrite-roasting Process of H2SO4 production. Copper, zinc, and a purple ore which is a valuable raw material in the iron industry, are also by-products of this process. With a daily production of

650 tons, the new pyrite-burning, H2SO4 installation of the Hoechst Dye Works is one of the largest plants of its kind. This non-urban, modern factory, which utilizes a closed combustion and exhaust system and a highly effective noise-isolation system, performs 4 operations: heat utilization, gas cleaning, contact, and absorption. The dust-containing mixture of SO2 and air is freed of floating particles and moisture in hot,roasting ovens used also in the manufacture of steam and electricity. The dust from the ovens and from the gas cleaning is collected for further utilization. The cleaned gases, emitting only 1/5 the amount of SO2 as the earlier process, escape after final absorption through a stack 135 m in height. The improved contact operation, which oxidizes SO2 to SO3, produces most of the H2SO4 in the Federal Republic (90%) and U.S.A. (95%). Since only 2% of the SO2 emissions are contributed by all H2SO4 manufacturers in West Germany, it is a fallacy to believe that the new installation will reduce atmospheric SO2 pollution substantially. The overwhelming portion of SO2 pollution is emitted from heat or electricity-producing fossil fuel installations.

11910

CLEAN AIR. (Chistii vozduh.) Text in Russian. NTO-SSSR., 10(12):17-18, 1968.

In 1967 power plants in the Soviet Union emitted about 7 million tons of SO2. SO2 removal from combustion gases is carried out in four ways: 1) Dispersion by means of high chimneys; this approach is being studied in the Central Thermotechnological Institute, Main Geophysical Observatory, and in the Erisman Institute of Communal Hygiene. A formula for calculating the waste in relation to location, topography, and climatic conditions has been established; this approach was recognized as promising only for power plants with capacities up to 2400 megawatts. 2) Preliminary sulfur removal from fuels has been little studied. 3) Gasification process of Christianovich in VNIINP and Giprogazoochistka has been patented. 4) Processes for SO2 removal in solid fuel combustion were presented by V. Lazarev and N. Pitelina. The most promising, according to economic indexes, are the cyclic magnesite and ammonia-autoclave methods, which give 95-95%, and 92% removal rates, respectively. The advantages of the former are that it uses the cheap magnesite and does not require cooling and dust removal; the advantages of the latter are the formation of high purity sulfur and the fertilizer, ammonium sulfate. The disadvantages of the cyclic magnesite method are difficulties in working with the suspension, high fuel consumption, and burning of magnesium sulfite crystals. The disadvantages of the ammonia autoclave method are the high ammonia consumption and the necessity for preliminary dust-removal. The SO2 formed in the petroleum refining is revoved by the Klaus method or the method of wet catalyzer to sulfuric acid. There are more than 20 methods for industrial H2S removal from gases. Most methods have the aim of technological exploitation of the removal H2S and are not suitable for sanitary purification. For the latter purpose the best are the oxidation methods which use adsorption of H2S to alkaline solutions (soda or ammonia) and oxidation to elemental S by a catalyzer. The oldest, iron-soda method, has many disadvantages (long duration, detrimental effect on the equipment, poor gas purification) and is to be replaced in U.S.S.R. plants manufacturing synthetic fibers, by an alkali hydroquinone method. Its advantages are: absence of suspension, simpler procedure of exploitation, and yield of high-purity sulfur. The method of dry oxidation with activated coal by which H2S is oxidized to elemental S has the advantage that the coal functioning as catalyzer and adsorber can remove H2S, CS2, and other impurities. Hydrocarbons and their products, which are important air pollutants from the petroleum industry, can be

11929

W. R. Browne, and M. Kawahata

FEASIBILITY STUDY - HYDRODESULFURIZATION OF FUELS UNDER CORONA DISCHARGE CATALYSIS. (FINAL REPORT.) General Electric Co., Schenectady, N. Y., Advanced Technology Labs., Contract PH 86-65-1. ((23))p., March 9, 1968. 7 refs.

A corona discharge hydrodesulfurization process was investigated for fuel oil containing 2.57% sulfur. A concentric tube, packed-bed reactor was used for the study. Up to 23% reduction in sulfur content, a linear relationship was shown between energy input to the oil and decrease in sulfur concentration. The energy required was too high to justify practical application of the process at its present state of development. Use of a desulfurization catalyst as a dielectric packing in the corona reactor improved the efficiency sixfold but reintroduced the problem of spent catalyst regeneration. In a separate short study, powdered bituminous coal was exposed to hydrogen in a corona discharge in the hope of converting FeS2 to magnetic FeS. Treated samples are being analyzed by the U. S. Bureau of Mines. (Authors' abstract)

11976

Veverka, V.

PROPOSAL OF AMMONIAC DESULPHURIZING FOR 100 MV. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 23-29.

A bicyclic ammoniacal method of desulfurizing thermal power plant flue gases is currently under study in Czechoslovakia. The proposed capacity of available equipment corresponds to the 100 MW power plant block and is considered the highest that can be attained at this time. Presumably, the equipment could be rendered suitable for greater power plant capacities by connecting parallel lines. According to the proposed method, combustion products in quantities of approximately 500,000 cu nm/hr, and containing 0.15 to 0.30 mol% SO2, are cooled, washed in two stages, reheated, and then drawn off to the stack. Regeneration of the solution, SO2 desorption, and crystallization of NH4(2)SO4 are included in the circuit of the first regeneration stage. The condensate resulting from the cooling of the desorbed SO2 is conveyed simultaneously with fresh water to the 2nd absorption circuit, where fresh ammonia is introduced. The diluted solution from the 2nd circuit is recycled to the lst circuit. Cooling of combustion products and fly-ash liquidation are problem areas of the desulfurization process. Cooling to 35 C is essential. It is proposed to cool the combustion products in two stages, first by desulfurized vapors and then by cold air. A wet fly-ash separator will be installed between the first and second stage coolers. Other technical and economic problems remain to be solved before the process is ready for large-scale application.

11985

Babcan, J. and L. Krejcirik

GAINING IRON FROM POWER PLANT ASHES. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 111-118.

Magnetic iron concentrates were experimentally isolated in granulation combustion chambers from the ashes produced by coal burning power plants. Laboratory as well as model magnetic separation tests were performed and data was obtained on the possible utilization of power plant ashes as metallurgical raw material. For a nearly quantitative isolation of magnetically separable iron compounds, a magnetic field of relatively low intensity (1.000 Oe) was sufficient. The total concentrate yield depends on the coal used and the manner of its combustion. The quality of the obtained iron concentrates is very good, equalling in many cases that of concentrates from the highest quality iron ores. Specific weight of the obtained concentrates is relatively low, due to the globular shape of the individual, hollow granules. The concentrates are suitable raw material for blast furnaces, but, because of their granularity, they must be agglomerated. (Author summary modified)

11996

Zahradnik, Lubomir and Jan Mazacek

OBTAINING TRACE AND RARE ELEMENTS FROM POWER PLANT FLY ASH. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 237-244.

The utilization of power plant fly ash for the production of rare and trace elements, such as germanium, gallium, beryllium, vanadium, boron, and uranium is discussed. The elements are present in the fly ash produced by the combustion of coal in chambers where absorption of ash by the slag is high. The accumulation of the trace and rare elements in the ash matter depends on the volatility of their compounds produced by chemical reactions occurring during combustion. Germanium and gallium show the highest degree of enrichment of all trace and rare elements. Germanium is converted during combustion to volatile germanium monoxide, germanium monosulfide, and germanium disulfide. Treatabl concentrations of both germanium and gallium are obtained in cyclone slag-top furnaces and boilers with strap gates. Their accumulation in fly ash may be due to surface sorption. On the other hand, the presence of beryllium and uranium is influenced by the disintegration and escape of vitrain components to the organic matter to which both metals are bonded. In grate and cyclone furnaces, a two-stage dust collecting system is used for germanium- or gallium-containing fly ash; a mechanical separator sorts out gross fly ash components and an electrostatic precipitator effectively absorbs the fine fly ash components.

12040

Frankel, R. J.

PROBLEMS OF MEETING MULTIPLE AIR QUALITY OBJECTIVES FOR COAL-FIRED UTILITY BOILERS. J. Air Pollution Control Assoc., 19(1):18-23, Jan. 1969. 16 ref.

Gaseous wastes and particulate emissions are produced in the process of burning coal to produce electrical energy. In attempting to control these gaseous wastes, changes in the operation efficiency of boilers and secondary equipment are likely to result, and in addition liquid and solid waste streams are produced. The interrelationships among the various forms of wastes and the effects of air quality control on process efficiency are often overlooked in studies of environmental quality management. The study was undertaken to evaluate the technical alternatives for handling gaseous and particulate emissions from coal-fired boilers and to determine the feasibility of meeting several standards simultaneously. The gaseous emissions of major importance in the combustion of coal are particulates, sulfur oxides and nitrogen oxides. Particulates can be controlled by a trade off among further preparation at the mine (for additional ash removal), type of boiler, use of dust control equipment and high stacks for for dispersion of residual emissions, if ambient air standards are considered. Sulfur oxides reduction depends currently on fuel substitution, limestone additives in the boiler and some form of contact process such as wet scrubbing, or the use of high stacks. Nitrogen oxides control in coal fired boilers is restricted to small reductions by either changes in boiler operation, such as lower excess air levels, adsorption during wet scrubbing or by dispersion from high stacks. (Author's Abstract)

12091

COAL COMES CLEAN FOR BURNING. Chem. Week, 103(7):64-65, Aug. 17, 1968.

The Bureau of Mines continues to investigate the desulfurization of coal despite the many problems. A chart analysis of coal desulfurization techniques with limited cost information is presented. A second chart compares the cost information for sulfur recovery from stack gas by various processes.

12092

FROM COAL TO SULFURIC. Chem. Week, 103(15):83, Oct. 12, 1968.

Operation of a prototype Monsanto Cat-Ox unit at the Portland, Pa. station of Metropolitan Edison, a subsidiary of General Public Utilities, has resulted in the development of enough data for the design of full-scale SO2 removal units for a range of boiler sizes. Cat-Ox is a catalytic oxidation system using an undisclosed vanadium catalyst for making H2SO4 from stack gas at new coal-fired electric power plants.

12234

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. (SUMMARY REPORT). Contract PH 86-67-128, AI-68-104, 155p., 1968. 8 refs. CFSTI: PB 179908

A Progress report is presented of a method being developed for sulfur dioxide removal from power plant stack gases. The sulfur oxides are absorbed in a molten mixture of lithium, sodium, and potassium carbonates, reacting with the carbonates to form sulfites and sulfates, which remain dissolved in excess carbonate. The molten carbonate-sulfite-sulfate salt mixture is then regenerated chemically, converting the sulfite and sulfate back to carbonate and the sulfur to hydrogen sulfide. The carbonate is then recirculated to the scrubber to continue the process. Testing shows the carbonate melt to be an excellent absorbent under realistic conditions, with a very fast reaction rate. The main problem in the absorption process is one of bringing the sulfur oxides into good contact with the melt. Recent reduction studies are emphasizing catalysis to increase the rate of the reduction reaction. Regeneration refinement is underway to eliminate sulfur tie-up and foaming problems from reduction catalysts. Corrosion studies of suitable metals and alloys, and contactor development, are described.

12253

Perry, Harry and J. H. Field

COAL AND SULFUR DIOXIDE POLLUTION. Preprint, American Society of Medical Engineers, New York, 9p., 1967. 19 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting and Energy Systems Exposition, Pittsburgh, Pa., Nov. 12-17, 1967.)

Presently about 143 million tons of pollutants per year are discharged into the air over the United States. Carbon monoxide represents about one-half of all pollutants, sulfur oxides are the next largest pollutant (15% of the total emission) followed by hydrocarbons and nitrogen oxides. To reduce sulfur oxide in the atmosphere, the following measures can be taken: use of low-sulfur fuels; desulfurization of fuel prior to use; selective mining of coal; injection of desulfurizing additives into the boiler; removal of sulfur oxides from stack gases; dispersion and dilution of the sulfur oxides through high stacks; mine mouth generation of power; and use of nuclear energy. Removal of sulfur oxide during in-process combustion has the advantage of being applicable to many existing plants where stack removal processes would be physically impossible to install. Reduction of the sulfur content of medium and high-sulfur coals is particularly beneficial for existing power plants and for all small installations. Froth floatation is less suited for this purpose, since pyrite and coal have similar surface properties. As a consequence, little sulfur reduction is achieved. Oxidation of pyrite to sulfur is prohibility expensive. Removal of SO2 from stack gases offers hope of the greatest reduction of this pollutant. The Reinluft process, Monsanto process, and the alkalized alumina process are briefly outlined. Capital investment of these processes ranges from 10 to 20 dollars per installed kilowatt with operating cost of about 0.75 to 1.50 dollars per ton of fuel burned after allowing credit for by-products. Mention of the Japanese Kiyoura process and the DAP-Mn process is also made.

12308

Borgwardt, Robert H., Thomas A. Kittleman, and Larry G. Turner

THE DRY-LIMESTONE PROCESS FOR SULFUR DIOXIDE CONTROL: A FIELD STUDY OF THE ROLE OF OVER-BURNING. Air Pollution Control Association, New York City, 19p., 1969. 10 refs. (Presented at the Air Pollution Control Association Annual Meeting, 62nd, New York June 22-26, 1969.)

Two series of injection tests for desulfurization of flue gas were made on a boiler. The boiler fired No. 6 fuel oil containing 2.3% sulfur at a rate of 10,000 pounds oil/hour at an operating load of 150,000 lbs steam/hour. Four different additives (2 limestone and 2 dolomites) were used. During the first series of tests, the effect of boiler load on the degree of burning of additives injected with the fuel was investigated. During the second series, the influence of particle size, iron content, residence time, and injection temperature on the effectiveness of the additives was studied. The dry-limestone process should not be applied by injection with the fuel; additives must instead be injected separately to achieve efficient utilization of the limestone. Overburning is at least partly responsible for the low efficiencies found when additives are fed to the burners. The lime produced by injection with the fuel is much less reactive with SO2 than lime that is not calcined in the combustion zone. Boiler load was an important variable affecting desulfurization when additives were fed with the fuel. This was due to the higher excess air used during low load. The tests indicated that there is an optimum particle size as well as an optimum injection temperature. Injection temperatures somewhat higher than 2400 F would be best for 2-micron particles.

12310

Squires, Arthur M. and Robert Pfeffer

PANEL BED FILTERS FOR SIMULTANEOUS REMOVAL OF FLY ASH AND SULFUR DIOXIDE: I. INTRODUCTION. Preprint, Air Pollution Control Association, New York City, 33p., 1969. 32 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 62nd, New York, June 22-26, 1969, Paper 69-202.)

Explanatory trials of three panel bed filters (using 16-30 mesh sand and operating at a face velocity around 12 ft/min) indicated a good probability that such a device can achieve 99% filtration efficiency on power-station fly ash, while simultaneously removing sulfur dioxide. A 'puffback' technique was used to remove fly ash and a portion of the sand from the gas-entry face of a panel. Of the three test units used, the first had 2 sides of plexiglass and 2 of metal, while the second was constructed entirely out of plexiglass. The third was also plexiglass, but with brass louvers. Filter sand did not have to be rendered free of ultra-fine particles when being cleaned for reuse. The louvers of the third test unit compel the smoke to flow upward through special gas treating spaces. This unit also used 8-12 mesh sand as a 'sealing solid' in addition to the 16-30 sand used as treating solid. Retaining screens should not be used at the clean face of the panel bed filter. The reactive solid used for the removal of SO2 should be regenerated before returning it to the supply bin. Based upon the experimental results, a commercial design would appear to provide a gas-treating capacity per unit ground area on the order of four times greater than an electrostatic precipitator of comparable efficiency. A program to develop a practicable panel bed device for simultaneous removal of fly ash and SO2 is recommended. (Author abstract modified)

12417

Seki, Shingo, Kiyoshi Kasahara, Takeo Kuriyama, and Makoto Kawasumi

STUDY ON THE UTILIZATION OF CINDER ASH FOR CONCRETE MANUFACTURING. Electric Power Industry, Tokyo (Japan), Central Research Inst., TR-C:68001, 26p., Feb. 1969. 9 refs.

In Japan, coal-burning power plants discharge about 600,000 tons of fly ash and about 3,400,000 tons of cinder ash annually. Unlike fly ash, cinder ash is a comparatively coarse ash that has not been widely utilized in cement manufacturing. Stream-curing and water-curing processes for its utilization are detailed. The methods make possible the production of cement paste, mortar, and lightweight aerated concrete of high quality from cinder ash, lime, and quenched blast furnace slag without the addition of portland cement. The maximum compressive strength of the mortar is 550 kg/sq cm after steam curing at 90 C for the day and 680 kg/sq cm after water curing at 20 C for 91 days.

12424

Skaperdas, George T.

COMMERCIAL POTENTIAL FOR THE KELLOGG COAL GASIFICATION PROCESS. (FINAL REPORT). Kellogg (M. W.) Co., Piscataway, N. J., OCR Contract 14-01-0001-380, Research and Development Rept. 38, 151p., Sept. 1967. 7 refs. CFSTI: PB 180358

The Kellogg coal gasification process represents a unique new method for attacking the problem of coal gasification. Steam and coal are injected continuously into a molten salt bath where they react to form synthesis gas, a mixture of hydrogen and carbon monoxide. The necessary heat of the reaction is supplied by circulating a heated molten salt stream. In addition, the molten salt mixture is chosen to catalyze the reaction so that it can be carried out at a relatively low temperature. In this report, the research that has been done on the process to date is summarized. Included are the chemical engineering studies on which the process is based, optimization studies and cost analyses of the various schemes under consideration, and work done in the areas of chemical research and mechanical development for those portions of the process deemed most critical. The general objectives of a proposed pilot-plant program are outlined. Since oxygen does not have to be added to the gasifier, the process permits important cost saavings over presently available processes for gasification of coal under pressure. Further savings result from the lower reaction temperature, which minimizes the sensible heat duty demands of the process. Moreover, as the coal is suspended in a salt melt, the physical properties of coal particles are not critical to the process. An additional advantage is that molten salt retains the sulfur originally present in the coal. The process thus eliminates the pollution problem associated with sulfur dioxide in stack gases The sulfur retained by the coal can be readily coverted to elemental sulfur by the Claus process.

12442

Atsukawa, Masumi

CONTROL AND REMOVAL OF SULFUR FROM THE FLUE GAS OF A LARGE SCALE COMBUSTION PLANT. DRY PROCESS OF SULFUR OXIDE REMOVAL FROM FLUE GAS, USING ACTIVATED MANGANESE OXIDE. Taiki Osen Kenkyu (J. Japa Soc. Air Pollution), 2(1):37-38, 1967. Translated from Japanese. 8p.

An activated manganese oxide absorption process for removing sulfur oxide from flue gases was investigated with successful results in pilot-plant studies conducted by two power companies. The process, which removes both S02 and S03 and yields ammonium sulfate, combines absorption with dust precipitation, absorbent regeneration, and ammonium sulfate crystallization. Homogeneous dispersion of the pulverized absorbent is obtained by mixing it first with a part of the main flow of gas and then adding it at high speed to the main gas flow. Since the tower contains no filler, power requirements are reduced. Manganese sulfate formed during the reaction, together with unreacted manganese oxide, flue-gas soot, and ash, are collected in a multicyclone and electrostatic precipitator. The collected materials are returned either to the absorbing tower or are converted to slurry for use in the regeneration process. The absorbent is regenerated in the oxidation tower by treating the slurry with aqueous ammonia under about 5 atm air. The slurry discharged from the oxidation tower is separated into an ammonium sulfate solution and recovered absorbent. The former is then introduced to the crystallization process and the latter is reintroduced to the absorption process. An advantage of the method is that the structure and capacity of a boiler are unaffected, since the process is applicable to normal flue gas temperatures.

12443

Thomas, Stanley

USE OF SOLID FUELS WITHOUT SMOKE EMISSION. Council for Scientific and Industrial Research, Pretoria (South Africa), Conf. Air Pollution, Capetown, South Africa, 1967, 36p. 3 refs. (Paper no. 2.)

Firing techniques and appliances which ensure the correct conditions for the efficient smokeless combustion of coal are discussed. These conditions include the provisions of sufficient air to enable combustible hydrocarbons to burn, sufficient turbulence to enable the air and the hydrocarbons to mix, sufficien time for the combustion process to completed, and a temperature high enough for the combustible gases to ignite. The mode of combustion, i.e., overfeeding or underfeeding, influences the smoke emission from a firebed. The mode of combustion is determined by the method of firing by hand or by the type of stoking appliance, if fired mechanically. While it is possible to hand fire most boilers with bituminous coal and at the same time comply with the provisions of the Atmospheric Pollution Act, it requires a great amount of skill on the part of boiler house personnel. Therefore, it is advisable to use either a smokeless fuel (anthracite, semi-anthracite, coke or char) for hand firing or to use one of the various types of mechanical stokers that are commercially available. The advantages of a mechanical stoker is that it fires steadily and consistently and can be operated mechanically. Moreover, as coal is fed in a steady stream, the air requirements for combustion can be precisely regulated. There is a mechanical stoker available for every type of boiler in operation today. Those discussed are the coking stoker, underfeed stoker, air modulating underfeed stoker, and fuel/air proportioning modulating stoker.

12446

van Doornum, G. A. W.

PROGRESS IN THE DEVELOPMENT OF SMOKELESS APPLIANCES FOR SOLID FUEL. Council for Scientific and Industrial Research, Pretoria (South Africa), Conference on Air Pollution Capetown, South Africa, 1967, 13p. (Paper no. 6.)

Appliances are described that permit the virtually smokeless combustion of bituminous coal in domestic heaters and industrial boilers. The design of the domestic appliance is characterized by a separate bunker for the storage of fuel, a provision that makes it possible to replenish the fuel supply of a stove without interfering with the combustion process. Preheated secondary air, well distributed, is admitted in an insulated combustion chamber. The hot combustion products can be used for space or water heating or to heat an oven or hotplate. The same principle can be applied on a larger scale, and hot water generators suitable for apartment buildings are now being manufactured. On an industrial scale verticle boiler with secondary air supply, smoke generation is almost completely reduced by injecting air through a small forge blower. Another boiler modification described facilitates ash removal from a boiler.

12503

Battelle Memorial Inst., Richland, Wash.

APPLICABILITY OF ORGANIC LIQUIDS TO THE DEVELOPMENT OF NEW PROCESSES FOR REMOVING SULFUR DIOXIDE FROM FLUE GASES. (FINAL PHAS I.) Contract PH-22-63-19, (114)p., March 1969. 32 refs. CFSTI: PB 183513

A study was undertaken, the purpose being to survey the literature and, on the basis of the findings, to assess the applicability of organic liquids to the development of new processes for removing SO2 from fossil fuel fired power plant stack gases. This literaOtu search also extended to the process engineering field to indicate the preferred methods of contacting the sorbent with the flue gas and the preferred technique of sorbent regeneration and recovery of sulfur values. A preliminary assessment of the applicability of organic liquids for cleaning both smelter effluent and power plant flue gases were made, and conditions required to assure adequate effluent gas plume dispersion were reviewed. Economic factors important to the comparison of organic liquids as scrubbing agents were reviewed, along with other means of sulfur dioxide removal.

12574

Baxter, W. A.

RECENT ELECTROSTATIC PRECIPITATOR EXPERIENCE WITH AMMONIA CONDITIONING OF POWER BOILER FLUE GASES. J. Air Pollution Assoc., 18(12):817-820, Dec. 1968. 9 ref.

Motivated by heightened recent interest, Koppers Co. has been experimenting with ammonia conditioning of power boiler flue gases for the purpose of improving the precipitability of the emitted fly ash. Chemical reactions resulting from NH3 injection are postulated. Measurements on three pulverized coal and two cyclone fired boilers, all os which emit acidic ash, are described. In all five cases, considerable but varying, increase in precipitator power input and collection efficiency resulted when gaseous NH3 in the amount of 15 ppm was injected between the economizer and air preheater. The conditioned fly ash showed decreased acidity and inconsistent change in electrical resistivity. Unless air heater temperatures were unusually high (greater than 400 deg F), tendency of the air heater to plug was an additional, but unwanted, result. At one station with high air heater outlet temperature NH3 injection has been adopted as a permanent solution to community pressure for reduction of stack discharge. NH3 injection downstream of the air heater produced no effect. Future plans are presented to continue the program beyond present results described in this interim report. Author's Abstract

12581

SULFUR OXIDE REMOVAL FROM POWER PLANT STACK GAS. USE OF LIMESTONE IN WET-SCRUBBING PROCESS. Tennessee Valley Authority, 104p., 1969. 22 refs. CFSTI: PB 183908

A report is presented of a conceptual design and cost study made on methods for removing sulfur oxides from power plant stack gases. The purpose is to develop, for various promising processes, the best design possible from existing data, estimate capital and operating costs on a uniform basis, and recommend further research and development needed. This is the second study in the series; the first was an evaluation of the dry limestone method-injection of limestone into the boiler without subsequent wet scrubbing. One of the objectives in the present study is to compare the merits of the wet and dry processes.

12645

SO2 CONTROL PROCESSES FOR STACK GASES REACH COMMERCIAL STATUS. Environ. Sci. Technol., 2(11):994-997, Nov. 1968.

The combustion of fuel for power generation accounts for 46% of the SO2 emitted to the atmosphere, and 58% of that total results from the combustion of coal. Air quality criteria for SO2, the prelude to federal control standards, are due from the Department of Health, Education, and Welfare by the end of the year. Several processes for control of SO2 in stack gases which have reached commercial status are discussed. These include: The Monsanto catalytic oxidation process; the Combustion Engineering, Inc. alkaline earth injection system; the Tennessee Valley Authority dry limestone injection process; the Wellman-Lord, Inc. Clean Air Demonstration Plant; and the Stone & Webster Engineering Corp.-Ionics, Inc. caustic scrubbing process. Several other processes that have not gotten beyond the pilot plant stage are also discussed.

12672

W. M. Crane, T. J. K. Rolfe

STEAM INJECTION AS A MEANS OF PREVENTING DEPOSIT FORMATION IN ECONOMIC BOILERS. J. Inst. Fuel, 41(334):426-432, Nov. 1968.

Some coals promote heavy formation of bonded deposits in shell boilers and this can lead to stoppage of the plant for cleaning. The work described here was aimed at reducing this deposit formation. The effect of a steam jet in the furnace tube on the formation of bonded deposits was assessed using an Economic boiler while this boiler was being used to supply the central heating load. A cola with a high chlorine content was burnt. In one test, used as a control, the boiler was operated in the normal way to provide the daily demand without cleaning the tube bank until the combustion chamber had become severely obstructed by bonded deposits. The boiler was then cleaned and the run was started again, but this time steam was supplied to a jet behind the bridge wall. This run was still in progress at the end of the heating season when, although slightly more coal than in the control run had been burnt, the tube bank was comparatively free of deposits. (Author's Abstract)

12797

Attig, R. C.

PILOT PLANT INVESTIGATION OF THE POTENTIAL OF DIRECT LIMESTONE- DOLOMITE ADDITIVE INJECTION FOR CONTROL OF SULFUR DIOXIDE FROM COMBUSTION FLUE GASES. Babcock and Wilcox Co., Alliance, Ohio. Research Center, Contract PH-86-67-127, Rept. I.R:68:4078-01:9 (ES-9477), (44) p., December 10, 1968. CFSTI: PB 184 049

Pilot plant tests have been made to evaluate the effectiveness of raw, hydrated and calcined limestones and dolomites injected into the flue gases to reduce sulfur dioxide concentration. The effects of additive fineness, temperature of injection and injection rate were also investigated for selected additives. The influence of limestone and dolomite on fly ash strength and on coal ash slag viscosity and fusion temperatures has been determined to evaluate the effect on ash deposition on furnace walls and in tube banks. The influence of additives on the ash collection properties as determined by bulk and in situ resistivity measurements has also been determined. Raw additives were most effective at Port 1 which is approximately 2300 F. Hydrates were somewhat more effective tha the raw stones at Port 1, and effectiveness did not decrease when they were injected into lower gas temperatures. The hydrates as a class had greater specific surface areas than the raw limestone prepared in the normal manner. This was believed to be one factor affecting their effectivenss, and tests with the raw additives indicated that increased fineness improved performance. The additives will have varying effects on ash deposition depending on the amount used and on the properties of the additive and coal ash. For the materials tested thus far, it is expected that large quantities of additive would decrease the extent of wall slagging and produce soft deposits under normal operating conditions. However, the great dust loading may place a burden on ash-handling and soot blowing equipment. Fly ash resistivity tests indicate that limestones and dolomites will make the fly ash more difficult to collect.

13015

Shealey, Leland D.

PRECIPITATORS INSTALLED DURING NORMAL OVERHAUL. Elec. World, 171(2):32-34, Jan. 1969.

Extensive tests on the mechanical dust collectors of the South Carolina Electric and Gas Company's Urquhart Plant indicated efficiencies ranging from 30 to 56%. Inspection showed plugging and excessive wear of the collector elements. Rather than restore the collectors of their 87% maximum efficiency rate, it was decided to install electrostatic pricipitators of a guaranteed 99% efficiency. The precipitator was installed in the 75-Mw unit during the unit's outage for overhaul. The mechanical collector was removed, and the precipitator shell was fabricated on the ground and lifted into place. Installation procedures are described. The total installation time was 12 weeks and 1968 cost was $350,000. Performance was above the 99% rate expected.

13019

Stelle, William W.

TALLEST SMOKE STACK FOR MITCHELL PLANT. Civil Eng. ASCE, 39(3): 44-47, March 1969.

A 1200 ft smoke stack is under construction at the Mitchell Plant of the Appalachian Power Company. The tall chimney is designed to pierce possible low level inversion blankets and discharge emissions to the atmosphere above. The height of the tower was calculated using the Bosanquet, Carey, and Halton equation to determine plume rise, and the Sutton equation for finding ground levels of sulfur dioxide. The stack will satisfactorily discharge and diffuse some 15 million lb of hot flue gases/hr. A slip form method of construction is being used for the concrete shell and steel lining.

13051

Leonard, Joseph W. and Edwin B. Wilson

COAL PREPARATION. Mining engineering, 21(2):107-108, Feb. 1969.

Much of the coal preparation research currently in progress originated from a comprehensive program developed by the National Center for Air Pollution Control for reducing sulfur content of coal. The research programs began with desulfurization of coals for removal of pyrite by specific gravity and magnetic separations. Attempts were aimed at obtaining a high-pyritic refuse as a feedstock to a sulfuric acid plant. Research is currently centered around a laboratory-sized model of a commercial, induced roll, magnetic separator which is capable of creating a magnetic field of 23,000 gauss. Research on coal preparation in relation to reduction of boiler tube corrosion is being carried out with the use of limestone additives, crushing, sizing, and coal cleaning. Treatment of coal refuse slurries with synthetic organic flocculants and the effects of low temperature on chemical and physical properties of coal are also areas of research. Drying of coal by acoustic energy and cleaning of coal by electrostatic separation are being studied. The U.S. Bureau of Mines has recently developed a wideline nuclear magnetic resonance device for measuring S-33 isotopes, which enables total sulfur content to be calculated.

13052

BREAKTHROUGH IN COAL COMBUSTION. Heating Ventilating Engr. J. Air Conditioning (London), 42(503):626-628, June 1969.

By burning coal in a fluidized bed, there is the possibility of cost savings through reduction in size and complexity. This is because both the combustion intensity and the rate of heat transfer can be increased. Since the bed operates at a very low temperature, corrosion is also expected to be reduced. The sulfur in the coal, which is normally emitted in the flue gases, can be retained in the bed, thus reducing air pollution problems. Smoke emission from domestic heating installations using solid fuel is being reduced in two ways. The first is the development of premium solid smokeless fuels for use in open grates and closed stoves and boilers. The second is the development of new appliances capable of burning cheap, highly volatile coals smokelessly. Investigations are also being conducted to find new uses and to increase the value of the by products from coal, and to find and develop non-fuel uses for coal itself.

13057

Debrun, G.

PREVENTION OF ATMOSPHERIC POLLUTION CAUSED BY THE POWER STATIONS OF ELECTRICITE DE FRANCE. (Les problemes de prevention de la pollution atmospherique provoquee par les centrales thermiques Electricite de France). Text in French. Chim. Ind. (Paris), 99(7):964-968, April 1968.

Principal pollutants emitted by the French power stations are fly ash, soot and sulfur oxides. To reduce these pollutants, the efficiency of dust collectors in old installations has been improved. All new stations are equipped with control apparatus to monitor the collectors, and existing equipment has been improved with regulation of the gas flow, addition of supplementary fields, and modernization of generators. Sulfur trioxide injection in the combustion gas has also been tried. Because of pollution control efforts, the emission of particulates from French power stations decreased from 109 kilotons in 1959 to 35 in 1966, while power output increased. Soot has been eliminated in the newer power stations, which burn heavy fuel oil, through careful control of combustion conditions, while in older installations the soot is neutralized with an alkaline reagent (ammonia, dolomite, magnesia, etc.). Dispersion of plumes has been accomplished by increasing the height of chimneys in several cases, and through research, determining the micrometeorological conditions necessary to disperse plumes. Research is being conducted in all these areas, and Electricite de France has set up a laboratory specializing in problems of atmospheric pollution.

13171

Rose, Harold J. and Richard A. Glenn

COAL CLEANING IN RELATION TO SULFUR REDUCTION IN STEAM COALS. Preprint, Am. Soc. Mech. Engrs., New York, Paper 58-A-147, 20p., May 1959. 31 refs. (Presented at the Annual Meeting of the Am. Soc. Mech. Engrs., New York, Nov. 30-Dec. 5, 1958).

Presently, about 60% of the bituminous coal used in the United States is mechanically cleaned. From the operating standpoint, the cleaning of coal at about 1.60 specific gravity to remove extraneous impurities is a straight-forward process which is widely used. Under these conditions, there is efficient separation of clean and refuse, high capacity of cleaning equipment, and fairly small loss of Btu in the refuse. As effective gravity of separation is lowered to attempt more extreme cleaning, plant operation becomes more difficult, the effectiveness of separation and/or the capacity drops, and the loss of Btu in the refuse increases. Because of the chemical and physical forms in which sulfur occurs in coal, only a small to moderate proportion of the total sulfur can be removed by any known coal-cleaning process. The proportion which can be removed varies considerably with different coal beds and localities, but the proportion removed is seldom large. The maximum removal of sulfur from coal by any known cleaning process does not approach the possible removal of sulfur dioxide from the stack gases after the coal has been burned. Other approaches to the sulfur problem include the stockpiling of low-sulfur coal for use when severe smog conditions are predicted and the placing of new electric utility plants at a great enough distance from metropolitan areas to disperse stack-gas emissions. The forms of sulfur in coal, their modes of occurrence, and the amounts of each form that are present in typical coals from several states are described.

13243

Kriz, Milan

DRY METHOD FOR REMOVING SULFUR OXIDES FROM CHIMNEY SMOKE. (Suche zpusoby cisteni kourovych plynu od kyslicniku siry). Text in Czech. Sklar Keram., vol. 15:374-376, 1965. 25 refs.

In 1952, the total emission of sulfur dioxide in Czechoslovakia reached approximately 2 million tons per year. With the building of electric power plants, where the primary source of energy is brown coal with a high content of sulfuric acid, this figure is growing. In new projects, 25% of the total cost is for installation of devices to reduce harmful emissions. The 'wet' removal process cools the emissions, thus reducing their ability to rise and be dispersed in the atmosphere. The latest trend is to use a 'dry' process which will remove the sulfur oxides at the temperature of emission. Three dry methods are commonly used: adsorption with metal oxides, adsorption of oxides on carbon, and catalytic oxidation. These methods are described and examples are given. Because all methods are technically difficult to achieve and expensive, it is concluded that there will probably never be an economic means of reducing power-plant emissions. However, because of the threat of emissions to the population, an economic method must continue to be sought.

13394

Austin, H. C. and W. L. Chadwick

CONTROL OF AIR POLLUTION FROM OIL-BURNING POWER PLANTS. Mech. Eng., 82(4):63-66, April 1960. 2 refs.

California law requires that stack-plume opacity not reach or exceed Ringelmann No. 2 shade for more than 3 min in any hr. To comply with this law, the Southern California Edison Company examined their industrial plumes. Gas emissions were measured for particulates, SO2, SO3, and NO. Plume opacity was found to be significantly affected by the amount and size of particulates, the amount of SO3 present, and the amount of water vapor present. Particulate removal was found to be most efficient with the use of an electrostatic precipitator which removes about 90% of the particulate matter. The most effective removal of SO3, SO2, and NO, 75-90%, could be accomplished by the use of a vanadium catalyst at high temperature, followed by introduction of ozone and electrostatic precipitation. This process proves to be economically unfeasible, however. It was found that NO formation is best limited by delaying the complete combustion in the boiler and protracting the flame path.

13501

AIR-POLLUTION CONTROL: THE SULFUR PROBLEM. Coal Age, 70(8):58- 62, Aug. 1965.

Current research on sulfur dioxide elimination from coal and flue gases is reviewed. Only a fraction of the coal reserves meets the standards set by the Public Health Service for new federal installations (0.7% sulfur for coal and 1.0% for fuel oil), and there is no practical means now available for removing enough sulfur from coal to make it conform to this standard. The alternat approach to control of sulfur dioxide emission is through the application of a process for recovering sulfur dioxide from the flu gases after burning but prior to emission from the stack. A gas-processing device could enable the reduction of SO2 emission to 300 ppm with a 3.4% sulfur coal, about 10% of the normal amount for such a coal. Three processes which appear promising are the Reinluft process, the alkalized-alumina process, and the catalytic gas-phase process. Costs for 1965 are given.

13523

Rees, R. Llewellyn

THE REMOVAL OF OXIDES OF SULPHUR FROM FLUE GASES. J. Inst. Fuel, 26(3):350-357, March 1953. 44 refs.

The development of flue-gas washing at power stations came about as a result of public pressure which, it is claimed, did not distinguish sufficiently between discharges from short and tall chimneys. Modern knowledge concerning the effects of dioxide upon men and plants has yielded no evidence for the thesis that ordinary flue gas, discharged hot and at reasonably high speed from well-designed chimneys, is harmful to health or to agriculture; on the other hand, washing the flue gas, so that washing may actually increase the local pollution in certain weather conditions. It is calculated that existing gas-washing processes cost the community more than the damage done by the dioxide that they remove. These processes are wasteful in that no useful material is recovered from the flue gas. The world shortage of sulfur has given impetus to the problem of devising new processes for the recovery or its compounds from flue gas; the use of gas liquor for the manufacture of ammonium sulfate from flue gas, which is being investigated in pilot plants, may provide a limited solution to the problem, applicable at stations which are situated so that cooling the gas is not objectionable even when the fuel is rich in sulfur.

13569

Boving, Jens Orten

IMPROVEMENTS IN OR RELATING TO THE TREATMENT OF WASTE INDUSTRIAL GASES. (Lodge-Cottrell Ltd., Birmingham, Great Britain) Brit. Pat. 435,560. 6p., Sept. 23, 1935. (Appl. March 23, 1934, 9 claims).

A process of removing sulfur oxides from the effluent gases of boiler and other power plants is described. The hot gases, without previous moistening, are contacted with a dry solid oxide, hydroxide, or carbonate of calcium at 400 to 625 C. The reaction between the sulfur oxides and the absorbing agent may be facilitated by mixing the calcium compound with a catalyst such as iron oxide. An electrical gas cleaner or cyclone separator may be placed in the path of the gases to remove any dust that may be present.

13570

Tieman, J. W.

THE SULFUR PROBLEM IN COAL: WHAT'S BEING DONE TO GET RID OF IT. Preprint, Bituminous Coal Research, Inc., Monroeville, Pa., 9p., 1967. (Presented at the Industrial Coal Conference, (Kentucky Univ.), April 12-13, 1967.)

From washability studies, petrographic analyses, and pulverization studies concerning the desulfurization of coal, it has been concluded that for improved pyrite removal, coal should be cleaned during or after pulverization at the power station. As a result of these findings, Bituminous Coal Research (BCR) investigated a two-stage process for cleaning coal using air classification and electrostatic separation. The air classifier was shown to be a good pyrite separator, but electrostatic cleaning was not successful. BCR then investigated the pulverizer itself for pyrite removal. Adjustments of the roll pressure increased the rejects through the tramp iron chute of the pulverizer to obtain a 25 to 35% reduction in the total sulfur content of the coal. Coarse materials from the air classifier that could not be cleaned by electrostatic separation were successfully cleaned by a wet method employing a filter rather than a dryer. It has been shown that the pulverizer alone can reduce the total sulfur content from 3.96 to 3.03%. If, in addition, the BCR two-stage system (air classification and wet cleaning) is used, the sulfur content of the coal can be reduced to 1.92%.

13578

Kenkyusho, Kogyo Kaihatsu

A PROCESS FOR ELIMINATING SULPHUR OXIDES FROM COMBUSTION EXHAUST GASES. Brit. Pat. 1,098,557. 6p., Jan. 10, 1968. (Appl. May 18, 1966, 6 claims.)

A method is described for eliminating sulfur oxides from combustion exhaust gases by passing them over activated carbon. The activated carbon is subjected to a three stage treatment comprising an absorption stage, a washing stage in which the absorbed sulfur oxides are removed, and a drying stage. In the drying stage, the sulfur oxides to be removed are divided into two streams, one of which is used continuously for drying. Part of the sulfur oxides in this stream are absorbed by the activated carbon being dried, and the outlet gas from this stage, with a lower temperature and lower concentration of sulfur oxides, is mixed with the second gas stream to produce a mixture of a suitable temperature for the adsorption stage. The temperature of the gas stream entering the adsorption stage should be less than 130 C. It is suggested that a coke layer be provided at the upstream side of the activated carbon to remove any soot or ash in the exhaust gases which might lead to obstruction in the layer of activated carbon. This process may be used by electric power stations where heavy sulfur-containing oils are burned, and by other industrial plants.

13584

Miller, F. G.

REDUCTION OF SULFUR IN MINUS 28 MESH BITUMINOUS COAL. Trans. AIME (Am. Inst. Mining Metallurgical and Petroleum Engrs.), 229(1):7-15, March 1964. 11 refs.

Pyritic sulfur can be present in all gravity fractions of coal, but it occurs in increasing quantities in the high gravity fractions. Organic sulfur decreases as the gravity increases in proportion to the amount of carbon-containing material removed as float. Sulfur removal by froth floatation can be accomplished only byremoval of pyritic sulfur. When recovery is maximum, the floatation tailings contain only pyritic sulfur. In a rougher float test, floatation should be stopped at some yield point below that at which the tailings sulfur becomes 100% pyritic. This will decrease the chances of floating high gravity materials in all stages, and result in a cleaner product. Three stage floatation was found to be the best for sulfur removal. Because hydrocyclones separate primarily by specific gravity, they are an effective means of removing pyritic sulfur. They are best used in combination with froth floatation if high yields are to be obtained because they tend to throw extreme fines of all gravities to their clean product.

13592

Mitchell, David R. and C. M. Smith

RECLAMATION OF REFUSE AT ILLINOIS COAL MINES. Illinois State Geol. Surv. Cir. 23, p. 45-52, 1938. 10 refs.

Coal refuse classified as pickings or the waste product from the hand-picking of coal on picking tables, conveyors, or railroad cars is a possible source of pyrite as a by-product in any process designed to recover coal from the pickings. Coal would come from the lightest end of such waste, and the pyrite, having a specific gravity of five, would come from the heaviest end. After the coal has been removed from the crushed waste, pyrite could be concentrated by jiggling, tabling, and possibly by flotation. Pyrite obtained from this process would meet sulfuric acid manufacturing requirements of 5% maximum carbon and 40% minimum sulfur. The economics of pyrite recovery are discussed in terms of 1929-1933 costs.

13636

Whitehouse, A. G. R.

THE HEAT OF ADSORPTION OF GASES BY COAL AND CHARCOAL. J. Soc. Chem. Ind., 45:13T-20T, Jan. 15, 1926. 18 refs.

Although the adsorption of gases by charcoal and other substances has been investigated extensively during recent years, the thermal change accompanying this phenomenon has received much less attention. In view of this experiments were conducted with different types of coal and charcoal to measure the adsorption of SO2, nitrogen, methane, CO, CO2, and oxygen using specially designed adsorption apparatus and a calorimeter. The heat evolved/cc of gas absorbed decreased as more gas was absorbed; the results obtained with charcoal and the different coals were very similar. The values obtained for the heat evolved/cc of gas adsorbed were: CO2:0.346-0.255 cal; SO2:0.627-0.359 cal; methane: 0.245-0.199 cal; oxygen: 0.19-0.17 cal; nitrogen:0.22-0.17 cal; and CO:0.198-0.188 cal. An equation is given relating the total heat evolved/g of adsorbent with the total volume of gas adsorbed/g of adsorbent. The gases studied were adsorbed more slowly by coal than by charcoal; the differences were most pronounced in the cases of methane and nitrogen.

13639

Wilson, Edwin R., Joseph W. Leonard, Richard C. Ulmer, Robert P. Hensel, and Richard W. Borio

REDUCING THE CORROSIVE PROPERTIES OF UTILITY COALS THROUGH MODIFICATION OF CURRENT COAL CLEANING PRACTICES. West Virginia Univ., Morgantown, Coal Research Bureau TR 32, 16p., Sept. 25, 1967.

By regarding ash, sulfur, and alkali minerals of coal as boiler corrosion-promoting constituents and the alkaline-earth minerals of coal as boiler corrosion-retarding constituents, it is possible to demonstrate the extent to which these minerals can be concentrated or reduced within selected size and/or specific gravity (sg) fractions of coal to yield a product which is substantially less corrosive. These results can be brought about by modifying current coal-cleaning practices and are often attainable without sacrificing the standard indicators of coal cleaning performance--ash, sulfur, and recovery. Coal-associated minerals which occur in nature might be mined and processed at the coal mine for subsequent addition to the product where cleaning procedures to reduce corrosion prove to be inadequate. Studies have shown that an increase of 1% in the alkaline-earth content of the coal can yield 25% reduction in the corrosion, rate while a decrease of 0.1% in the sodium oxide content of the coal can yield a 20% reduction in corrosion rate. It is impossible to predict the direction of change in concentration of these minerals which results from changes to the sg of separation. A knowledge of both the direction and magnitude of change in the concentration of minerals which affect corrosion is necessary. Coal-cleaning schemes must be developed from detailed knowledge of the coal seam to be mined. Successful application of the cleaning measures described could possibly reduce boiler maintenance at power plants and lead to reciprocal premium-price arrangements for such coals.

13663

Holbrook, E. A.

THE UTILIZATION OF PYRITE OCCURRING IN ILLINOIS BITUMINOUS COAL. Ill. Univ. Bull., Circ. 5, 14(51), 46p., Aug. 20, 1917.

Pyrite occurring in Illinois bituminous coal is usually rejected as a deleterious impurity. Its heating value is small, and the sulfur dioxide gas formed from its combustion with water vapor forms an acid corroding boiler flues and stacks. Experiments were performed with commercial-scale equipment at the University of Illinois to develop a simple washing or ore-dressing process for recovering clean pyrite with coal as a by-product. The power required and the 1912 cost of operation, as well as of capital investment, were determined for a plant capable of preparing nearly pure pyrite and commercial coal comparable to ordinary screenings. The tests indicate that the separation of pyrite from coal presents no problem when performed by crushers, screens, and concentrating machines adapted to ordinary ore dressing work. An average plant will recover 81% of the pyrite in coal. If the middlings product from the jig are crushed and retreated, recovery will be increased by about 6.4%. This pyrite will average more than 40% sulfur. The successive steps essential for complete treatment are illustrated. The amount of coal recovered is considerable, averaging 18 to 20 t/day. It is emphasized that ordinary coal-crushing machinery is not suitable for crushing raw pyrite. Only breakers designed for hard rock should be used. Separation of pyrite and coal is accomplished by a simple, revolving screen. A considerable proportion of the crushed ore contains fine pyrite, and this is separated by an ore-concentrating table. A process is included for recovering and cleaning sludge water.

13674

Penny, G. W., J. T. Reese, and J. Greco

ELECTROSTATIC PRECIPITATION IN THEORY AND PRACTICE. Eng. Digest, 29(12):61-65, Dec. 1968.

Although electrostatic precipitators are generally assumed to be efficient in theory and practice, the behavior of dust on the collecting electrode constitutes a major uncertainty in their performance. Small differences in the nature of a dust can have pronounced effects on both spark-over voltage and adhesion, producing large differences in efficiency. For these reasons, and because a particle is not necessarily caught when it reaches the collecting electrode, the actual efficiencies of electrostatic precipitators bear little relation to those predicted by equations derived from calculated values of drift velocities. Important variables affecting the performance of electrostatic precipitators in power plants are sulfur content of the fuel, the exit temperature of the flue gas, the flow rate of the gas, and sulfuric acid, produced when the flue gas temperature is below acid dewpoint. Among the remedial measures undertaken by TVA to improve the efficiency of its precipitators, the removal of sulfuric acid by the injection of ammonia into the flue gas appears to be the most promising. The estimated total annual operating costs for two units will be about $40,000, a portion of which may be offset by a reduction in the high costs of induced-draft fan maintenance arising from excessive fly-ash corrosion. In addition, the possibility exists that ammonia feed rates may be reduced as much as 50% by improved methods of distributing the ammonia in the flue gas.

13721

Tanaka, Kusuyata and Hisao Hattori

DESULPHURIZATION AND ATMOSPHERIC DIFFUSION OF FLUE GAS. Proc., World Power Conf., Tokyo, Oct., 1966, p. 1403-1413. (Presented at the Tokyo Sectional Meeting, Oct. 16-20, 1966, Paper 145.).

Japan imports 85% of its coal from the Near East, and since the mean sulfur content of this coal is 2.28%, air pollution is a pressing problem. Wet methods of desulfurization are not practical because the required cooling of waste gases decreases the diffusion of contaminated air in the vicinity of power plants. Dry methods, including adsorption, absorption, and catalytic processes, have been studied for 10 years, but none has yet been put to practical use by power stations. Gas conveying absorption appears to involve the fewest chemical engineering problems, and pilot plants are currently experimenting with activated manganese and lime blow-in methods. In the former method, powdered MnO2 absorbs SO2 and SO3 at 100-150 C. The absorbent is separated from the gas by electric collectors after which part of it is returned to the gas stream for recycling, and part is regenerated as MnO2. The lime process does not require regeneration. The construction of tall chimneys for the diffusion of stack gases is reported. For prediction of diffusion from chimneys, theoretical investigations by diffusion equations, field investigations, and wind tunnel experiments are employed.

13767

Corbett, P. F. and R. F. Littlejohn

REMOVAL OF SULPHUR OXIDES FROM FLUE GASES. Brit. Coal Util. Res. Assoc. Monthly Bull., 16(10):437-444, Oct. 1952. 53 refs.

Electric power stations represent a case where the treatment of flue gas to remove SO2 appears practical because of the large amounts of coal used. A number of suggestions have been made for reducing SO2 to sulfur, but the SO2 must first be removed and recovered from the flue gases. The catalytic oxidation of SO2 to form sulfuric acid has also been suggested. Other methods are the absorption of SO2 in an aqueous solution of an alkali or alkaline formate, scrubbing the gases by calcium polysulfite in the presence of a catalyst to give a polythionate, and the absorption of sulfur-containing gases in an alkaline solution of sea salt and its subsequent electrolysis. The neutralization of SO2 by ammonia has received much attention because the sulfur is recovered in a marketable form. The two best known gas washing processes are those originally installed at the Battersea and Fulham power stations. The Battersea plant was designed to remove 95% of the SO2 in flue gases from coals whose average sulfur content was 0.8 to 0.9%. It was based on the catalytic oxidation of SO2 in an aqueous solution followed by neutralization of the resultant sulfuric acid. Fulham adopted a closed cycle process based on the production of calcium sulfate. However, even if all power stations developed processes for recovering SO2, only a small percentage of the SO2 in the atmosphere would be removed because of the many other sources of this pollutant.

13813

Cochran, Neal P.

COAL RESEARCH. Mining Congr. J., 51:83-88, Feb. 1965.

The Office of Coal Research is conducting several programs on coal conversion and combustion. Research on converting coal to liquids includes a study on the production of gasoline from coal, a study on the direct hydrogen-carbon reaction to produce high Btu gas and liquid fuels, a study on carbonization, including the construction of a pilot plant at the Princeton Laboratory, and a study for reacting coal and crude oil residuum in a fluid coker to skim off both the coal and residue for production of more valuable fuels. A recently completed program on corona processing revealed that this procedure is economically unfeasible. Work is continuing in converting coal to pipeline gas. A slagging, pressure, steam oxygen, fixed bed gasifier has demonstrated that lignites containing as much as 35% moisture at ash fusion temperatures around 2600 F could be gasified with high throughput rates and low oxygen consumption. Hydrogasification tests of char at 3000 lbs have indicated the feasibility of a two-step process of converting coal to pipeline gas. Coal combustion research programs have shown that nitrous oxide in stack gases can be reduced 62% by burning in 5% excess air. Current programs are investigating reduction of stack gas SO2 pollution through by-product recovery and production of sulfuric acid.

13817

Pechkovskiy, V. V., A. N. Ketov, T. G. Mal'tseva, and V. G. Pridatchenkov

THERMOGRAPHIC STUDY OF THE REACTION OF SULFUR DIOXIDE WITH CALCIUM CARBONATE IN AN OXIDIZING ATMOSPHERE. (Termograficheskoy issledovaniye vzaimodeystviya sernistogo angidrida s karbonatom kal 'tsiya v okislitel 'noy atmosere). Text in Russian. Izv. Vysshikh Uchebn Zavedenii, Khim. i Khim. Teckhnol., 6(4):991-996, 1963. 11 refs.

The possible usefulness of calcium carbonate as an absorber of SO2 and SO3 is supported by data from a thermographic analysis of the system CaCO3(CaO) SO2(SO3) - air. Sulfur dioxide in an oxidizing atmosphere reacts energetically with calcium oxide produced by decomposition of calcium carbonate and limestone, calcium sulfate being formed through a sulfitation step. Calcium sulfite is the basic product at 300-500 C, calcium sulfate at higher temperatures (up to 1000 C). Calcium sulfate may also be formed through oxidation of SO2 to SO3 and reaction of the latter with oxygen and calcium carbonate. These chemical mechanisms are of importance in the lime method of removing SO2 from power station flue gases. Data both from the literature and from new experimental work were used in the study.

13829

Johswich, F.

WASTE GAS DESULFURIZATION. IMPORTANCE AND PRACTICAL USE. (Abgasentschwefelung. Bedeutung und praktische Moglichkeiten). Text in German. Brennst.-Warme-Kraft, 14(3):105-115, March 1962. 21 refs.

Neither fuel desulfurization nor high stacks are sufficient for solving the problem of ever more SO2 emitted into the atmosphere. The need for an effective and economical waste gas desulfurization method is pressing. Of the numerous dry and wet desulfurization processes, none works really satisfactorily. The wet processes, e.g., the Fulham-Simon- Carves method and the sodium sulfite/bisulfite-zinc oxide method, have the disadvantage that the SO2 scrubbing process is accompanied by a heat exchange between gas and scrubbing fluid. As a consequence, the gas leaves the scrubber saturated with water vapor and cools further, which leads to caking and lack of thermal buoyancy so that the smoke plume touches ground level too soon. The dry methods usually operate on the principle of SO2 absorption or adsorption on aluminum oxide, manganese oxide, silica gel, and activated coal. The main disadvantage of the absorption methods are the high costs. Of the adsorption methods, the Reinluft process seems to be the most promising one. It operates on the principle of SO2 adsorption and oxidation to SO3 in the presence of oxygen. Through subsequent hydration, SO3 is converted into sulfuric acid. Instead of activated coal the Reinluft process uses semi-coke, which is activated by soaking in sulfuric acid and driving off the acid at 400 C. Investment costs are 4,300,000 DM (1962) for fuel oil with 2% S and 4,500,000 DM for fuel oil with 3.5% S. As with any gas cleaning system, the space requirement is large. No special stack is required. The process can also be used for gases which contain H2S, COS, or CS2.

13835

Fraser, Thomas and William L. Crentz

WASHING CHARACTERISTICS OF THE PITTSBURGH COAL IN A HIGH-SULFUR AREA IN GREENE COUNTY, PA. Bur. Mines Tech. Paper 689. Bureau of Mines, Washington, D. C., 1946, 85p. 13 refs.

Approximately 90% of the Pittsburgh-seam coal remaining in Pennsylvania occurs in the southwestern portion of the state in Greene and Washington counties and is regarded as the principle source of metallurgical fuel for the Pittsburgh industrial area. This coal is known to be high in S content, generally increasing toward the west. The Bureau of Mines undertook an intensive study of the characteristics of the coal in a typical area of Greene county to obtain more information about the nature of the S. Channel, and sometimes bench, samples were taken from seven working areas of a typical mine in the area. The samples were float and sink-tested at specific gravities (sg) of 1.35, 1.45, and 1.60. Sulfur determinations were also made. A variation of S content of the samples between 0.93 and 3.37% was found. Local groups of samples showed that distances as small as 100 ft have considerable effect on S content. A larger portion of the S in high-S samples was in the organic and finely disseminated pyritic forms, indicating that peaks of high-S coal will not be leveled to any great extent by washing. Only coal from below the bearing-in bands responds favorably to washing. Crushing before separation brought about no substantial improvement in S reduction unless the coal was crushed to 28-mesh or finer. Separate handling of the coal from the working places that produce coal of low float-S content would make it possible to produce a washed coal of 1.30% S content by washing at 1.6 sg. The yield of this grade would be 56.6% of the run-of-mine coal, leaving 40.5% from high-S places to be used as high-S steam coal. Z The largest yield of low-S coal would be obtained by separate washing at 1.35 sg. Practical application of this scheme must wait for the development of a washing process that will operate efficiently at low gravity.

13856

Brennan, Peter J.

COAL RESEARCHERS ARE GRAPPLING WITH SULFUR. Chem. Eng., 74(21): 114-116, 118, Oct. 9, 1967.

Various processes for controlling sulfur emission into the atmosphere, caused by the combustion of coal, are discussed. Researchers at the U. S. Bureau of Mines Coal Research Center are studying an approach based on magnetism for removing pyrites from coal before combustion. They have found that coal is transparent to certain kinds of microwave emissions that are absorbed by pyrites: they reason that such absorption could heat the pyrites to the pyrrhotite-transition temperature without adversely affecting the coal itself, thus allowing magnetic separation. The pyrites must be heated to this temperature (about 750 F) because they are only slightly magnetic, whereas pyrrhotite is strongly magnetic. The Center has also developed a two-stage air classification system that takes advantage of the density differential between coal and pyrites to clean the coal as it is fed to the burners. Another method utilizes the difference in hardness between coal and pyrites by using a tramp-iron chute in the pulverizers to reject larger pieces of pyrites before grinding. Methods of removing sulfur from stack gases, such as using dolomite to neutralize SO2 in combustion gases and adsorption processes, are described, and some unconventional, relatively inexpensive methods are also discussed.

13857

Frazier, J. H.

COAL FIRED BOILER STACK EMISSION CONTROL. Nat. Eng., 73(8):8-10, Aug. 1969.

A large corporation, through various divisions, operates a large number of coal-fired boilers. When emissions are marginal, or excessive, the boiler units are revised or replaced to comply with new regulations regarding stack emissions. Spreader stoker units are equipped with dust collectors varying in type, arrangement, and the amount of cinders returned to the furnace for reburning. Most of these units are also equipped with either economizers or air heaters for heat recovery. Pulverizer units have mechanical dust collectors, except for four plants where electrostatic units have been installed. The varying equipment, locale, coal, and new or foreseeable applicable emission regulations combine to required a study of emissions from each boiler. However, it is stressed that testing should only be done to satisfy the operator or the air pollution control group, since promiscuous stack testing serves no purpose.

13950

Thurlow, G. G.

FLUID BED COMBUSTION. Preprint, Combustion Engineering Assoc., Hayes, Great Britain, 16p. Nov. 11, 1968. (Presented at the Combustion Engineering Assoc. Meeting, Birmingham, Great Britain, Oct. 15, 1968, Document 8533.)

The technology of fluidized bed combustion and current research and design efforts in its development are described; the application of this system to steam and hot-water boilers is considered potentially the most important advance in the burning of coal since pulverized fuel firing. The principle of the system is to feed coal into a fluidized bed of coal and ash particles; the coal is rapidly dispersed throughout the bed, reacts with the incoming air, and so is burned. The rapid motion of the particles gives a high rate of turbulent mixing and produces a reaction between the coal particles and the air passing through the bed; also, these same rapidly moving particles lead to a high rate of heat transfer between the bed and surfaces in contact with it. By extracting heat from the bed as combustion proceeds, it becomes possible to keep the bed temperature below that at which the particles sinter while maintaining a high rate of chemical reaction and therefore heat release rate. Consequently, unlike earlier proposals of combustion units using fluidization, the ash particles do not get sticky and coalesce, but remain as discrete particles, allowing the heat transfer surfaces to stay clean and effective. By carrying out at least 50% of the heat transfer to the water or steam tubes with the bed, it is expected that smaller, cheaper boilers can be utilized. In addition, the fact that no surfaces are exposed to high gas temperatures should lead to savings in maintenance, while the low bed temperatures should reduce problems of corrosion, deposition, and atmospheric pollution. Other advantages, such as in the types and size of coal that can be burned, are also foreseen. Details of the process are given, and its application to power station water tube type boilers and industrial shell-type boilers is described. It is emphasized that the system is still in the developmental stage, with many problems still to be worked out. A record of extensive discussions by participants at this and two subsequent meetings is included.

13983

Idel'chik, I. Ye., V. P. Aleksandrov, and E. I. Kogan

STUDY OF DIRECT-FLOW CYCLONES FOR A GRES ASH-TRAPPING SYSTEM. (Issledovaniye pryamotochnykh tsiklonov sistemy zoloulavlivaniya GRES). Text in Russian. Teploenergetika, no. 8:45-48, Aug. 1968.

A direct-flow cyclone for a GRES (state regional electrostation) ash-trapping system was tested under laboratory and industrial conditions both in a self-draughting arrangement without an intermediate cyclone, and with a forced draught and an intermediate cyclone to remove dust. The four cyclone variants tested have a diameter of 350 mm and are described. The optimum variant (conoidal rosette with a flow gathering angle of 24 deg) gave a purification coefficient of 61% (as compared to 49% for the basic variant), but the hydraulic drag coefficient was significantly increased. The following dependences are plotted: purification coefficient vs degree of suction; purification factor vs average flow velocity; and fractional purification factor vs particle size.

14001

Copeland, A. E., G. N. Haynes, and C. W. Porterfield

FINE COAL CLEANING WITH TABLES. Mining Congr. J., 40(10):44-47, Oct. 1960.

Full-seam mechanical mining produces coal which, due to its increased ash content, requires effective cleaning. Since 1954, this requirement has been met at the preparation plants of the Pocahontas Fuel Co. by means of Deister single-deck or double- deck cleaning tables. The cleaning capacities of these tables are determined primarily by the washability of the raw coal, ash requirements in the clean product, the amount of refuse in the raw feed, and size and ash content in the raw feed. In general, the capacity of the tables is decreased by lower ash requirements in the clean coal, by adverse washability of the raw coal, by an increase in the percentage of refuse, and by increased fines in the raw feed. A comparison of the washabilities of the various size fractions in the raw feed used at Pocahontas shows a good composite washability for raw 3/8-in. slack, the size usually tabled. Coarse sizes, which have a more adverse washability, tend to be cleaned in the first few of the 20 cleaning zones of a table; a large percentage of middle sizes, which have the most favorable washability, comes off further along on the clean coal side of the table; and extreme fines are washed over without any cleaning in the first few zones because of the rush of feed water. Cleaning efficiency drops off at about 50 mesh. Maintenance costs are low for either type table and even lower for a double-deck table, since only one drive mechanism is involved. Similarly, the operating cost of a double-deck table should be one-half that of the single-deck: only one 3-hp motor is required.

14057

Ketov, A. N., V. V. Larikov, V. V. Pechkovskiy, and A. S. Shligerskiy

DRY LIME METHOD FOR REMOVING SULFUR DIOXIDE FROM TETS FLUE GAS. (Sukhoy izvestkovyy sposob ochistki topochnykh gazov TETS ot sernistogo angidrida). Text in Russian. Zh. Prikl. Khim., 41(4):725-729, 1968. 3 refs.

Crushed coal containing 3.76% sulfur was burned under laboratory conditions at a rate of 2.8 g/min, and an intermediate industrial product containing 5.97% sulfur was burned at 3.49 g/min, to determine factors affecting SO2 removal from TETS (heat and electric power plant) flue gas by the dry lime method. Sulfur dioxide removal at furnace temperatures of 1100-1200 C reached 50-60% with stoichiometric addition of lime. An excess air factor of 1.15 with 10-20% excess lime is recommended. The experimental arrangement is described and data are tabulated.

14087

NEW PILOT PLANTS TACKLE SO2 POLLUTION. Chem. Eng. News, 44(27): 36-38, July 4, 1966.

By 1980, the coal-fueled electric power industry will produce about 65% of the total sulfur dioxide emission. To meet mounting pressure for conversion to natural gas, coal and power companies are working on facilities for extracting SO2 from stack gases. The most promising of these are embodied in a Japanese pilot plant at Omuta on the island of Kyushu, the Monsanto prototype program at Portland, Pa., and the Bureau of Mines pilot plant at the Pittsburgh Coal Research Center. The Japanese plant will operate a dry catalytic oxidation process on bypass power-plant flue gas. Sulfur dioxide will be oxidized to sulfur trioxide over vanadium pentoxide at 380 to 450 C. Moisture present in the gas will react with the sulfur trioxide to form gaseous sulfuric acid, after which ammonia will be injected into the system to form pure ammonium sulfate crystals. The Monsanto process is an adaptation of the contact catalytic procedure in sulfuric acid production. Gas from coal combustion in the boiler passes first through an electrostatic precipitator for removal of solid fly ash particles. In the *next phase, vanadium pentoxide converts 90% of the* sulfur dioxide to sulfur trioxide at about 880 F. The Bureau of Mines has developed an alkalized alumina process for absorbing sulfur dioxide from stack gas and recovering elemental sulfur. Desulfurization of coal is considered less promising than these recovery methods, since most coal contains an irreducible minimum of chemically bound sulfur.

14137

Pollock, W. A., J. P. Tomany, and Garry Frieling

FLUE-GAS SCRUBBER. Mech. Eng., 89(18):21-25, Aug. 1967.

Results are given of tests on the Turbulent Contact Absorber, a wet scrubber for removing sulfur dioxide from the flue gas of central power stations, that is designed and manufactured by Universal Oil Products Co. This scrubber utilizes turbulent motion of mobile packing to maintain high mass-transfer rates and efficient particulate collection over a fairly wide range of flows with low pressure drop, all in the presence of reasonably dense, low pH slurry and at high gas velocities. It was concluded after testing that a system comprised of direct limestone injection into the furnace in combination with wet scrubbing is practical for the simultaneous removal of fly ash and sulfur dioxide from coal-burning power-plant flue gases. Fly-ash collection efficiencies on the order of 98% and overall sulfur dioxide removal of 91% can be expected with the system at wet scrubber pressure drops of about 4.5 in. wg. For a generating capacity of 25 MW equivalent to 100,000 cfm of flue gases at 300 F, the investment and operating costs as of 1967 are about $10 per kw and $1.17 per ton of coal.

14159

Thomas, Fred W.

TVA'S AIR QUALITY MANAGEMENT PROGRAM. Proc. Am. Soc. Civil Engrs., J. Power Div., Paper 6483:131-143, March 1969. 18 refs.

The air quality program of the Tennessee Valley Authority as related to its fertilizer and coal and nuclear-fired power plants is reviewed. Preventive aspects of pollution control are basic to the program designed for steam-electric generating plants. Plants are located at sites where terrain is favorable to effective dispersion, and air quality measurements are recognized in planning and designing plant structures. The program is supplemented by an extensive monitoring system for measuring sulfur dioxide, fly ash, ozone, and nitrogen oxide emissions. Mobile sampling equipment is used in conjunction with stationary monitoring systems because it appreciably shortens the period required to define air quality in the vicinity of a plant. TVA also conducts extensive research studies on plume dispersion, levels of ground level fumigation during inversion breakup, and chemical processes for the removal of SO2 from flue gas. At nuclear plants, an extensive network of instruments monitors airborne particulates, radioiodine, heavy particulate fallout, and rainwater. TVA has sought to prevent deleterious effects from SO2 emissions primarily through the use of high stacks designed to limit SO2 concentrations at ground level. As unit size and plant capacity increase, stack heights are being raised from 170 to 800 to 1000 ft. With increasing worldwide attention focused on techniques for converting SO2 to sulfuric acid or fertilizer, TVA is now exploring the use of limestone in pulverized coal-fired units and cyclone-furnace units. Where fly ash creates a nuisance problem, TVA is substituting 95% efficiency precipitators for mechanical collectors.

14162

Saltsman, R. D.

FACING UP TO THE SULFUR CONTENT OF COAL. Preprint, American Society of Mechanical Engineers, New York, United Engineering Center, 8p., 1969. (Presented at the Industrial Fuels Conference of the ASME, St. Louis, Mo., Feb. 11-13, 1969.)

The industrial and commercial users of coal must rely primarily on low-sulfur coal for some time to come. To ensure an adequate supply of this naturally occurring or pre-processed low-sulfur coal, it will be necessary to develop efficient air pollution control devices for the electric utilities. The use of dry additives, such as dolomite and limestone, could provide the industrial user of coal with a means for complying with air pollution control ordinances which require reduction of SO2 emission by 30 to 40%. Chemical processing with a central product recovery and reagent regeneration plant would offer the industrial user an efficient air pollution control process that would allow the use of a relatively high-sulfur coal. Other methods of reducing SO2 emission, such as wet scrubbing and catalytic oxidation, are also discussed.

14194

Ito, F.

AN EXAMPLE OF SMOKE PREVENTION FOR COAL FIRING APPARATUS OF STEAM JET TYPE. (Joki funshashiki sekitan nensho sochi ni yoru baien boshi no jitsurei). Text in Japanese. Netsu Kanri (Heat Engineering) (Tokyo), 20(2):32-36, Feb. 1968.

A steam jet coal-firing apparatus reduced dust from 2.26 to 0.27 g/cu nm, eliminated black smoke, increased heat efficiency to 50%, and lowered exhaust gas temperatures from 329 to 307 C. Coal content of dust dropped from 12.2 to 8.5%. The size of the apparatus and the number of jets depend on the individual boiler. The inner diameter of the apparatus ranges from approximately 3 to 6 mm and nozzle height from 450 to 650 mm. Steam pressure requirements vary from 0.7 to 1.5 kg/sq cm. Preferably, boiler pressure should be above 4 kg/sq cm. Cost of the apparatus is calculated at 300,000 yen (1968) for pressure less than 4 kg/sq cm and a heat transfer area greater than 15 sq m; at 250,000 yen for pressure less than 4 kg/sq cm and a heat transfer area less than 15 sq m; at 120,000 yen for pressure above 4 kg/sq cm and with a heater; and at 30,000 yen for pressure above 4 kg/sq cm but without a heater.

14207

Squires, Arthur M.

AIR POLLUTION: THE CONTROL OF SO2 FROM POWER STACKS. PART II. THE REMOVAL OF SO2 FROM STACK GASES. Chem. Eng., 74(24):133-140, Nov. 20, 1967. 34 refs.

By adding finely divided MgO to residual oil and operating with little excess air, a power company was successful in controlling SO3 emission. A pilot electrostatic precipitator was tested working at temperatures that could effectively reduce the opacity of a plume from an oil-fired station. Injecting raw dolomite or limestone into furnaces provides an easy means of eliminating SO2 from the stacks of power stations. Another company reported pilot plant operations in which a stoichiometric amount of raw dolomite was injected into a boiler, and a slipstream of flue gas was treated in a pilot scrubber. More than 90% of the SO2 was removed. In Wisconsin, a company which had not used a scrubber in operations where a stoichiometric amount of raw limestone was injected, reported data to support the contention that a system using limestone could remove more than 80% of the SO2. Methods of recovering stack-gas sulfur, such as reduction with methane, are also discussed.

14223

French Electrical Industry (France), Oise Thermal Production Regional Group

ADAPTATION OF COMPRESSED-AIR SWEEPING INSTALLATIONS ON DUST-REMOVING DEVICES. (Adaptation d ' installations de ramonage a l' air comprime sur des depoussiereurs.) Translated from French. (12)p., (1968).

Experiments have been conducted at the Porcheville power station on compressed-air sweeping devices for dust removers. The test installation includes 14 sweepers. Each sweeper is made up of a blowing line and an outdoor sweeping head. Utilization, operating conditions and costs are discussed. The results obtained are very satisfactory: the precipitation panels remained clean after 2 years of operation.

14261

SO2 STACK GAS GIVES (NH4)2SO4. Chem. Eng. News, 44(26):23, June 27, 1966.

Pilot-plant studies are underway in Japan for a dry process for removing sulfur dioxide from stack gases and converting it to saleable ammonium sulfate fertilizer. In the recovery procedure, sulfur dioxide is oxidized to sulfur trioxide over vanadium pentoxide at 380 to 450 C. Moisture in the gas reacts with the sulfur trioxide to form sulfuric acid. Ammonia gas is then injected in the system to form pure ammonium sulfate crystals. The estimated 1966 cost of the process is 0.09 mill per kwh, or 44 cents per metric ton of fuel oil, for a 600-Mw electric power station. The system is expected to obtain 80 to 90% recovery of sulfur dioxide and to produce about 100,000 metric t/yr of ammonium sulfate.

14269

AVCO Corp., Lowell, Mass., AVCO Applied Technology Div.

EVALUATION OF GRANULAR BED DEVICES. PHASE III. Contract PH-86- 67-51, AVATD-0107-69-RR, 90p., June 1969. 19 refs. FSTI: PB-185561

Recent interest in dry sorption processes for SO2 removal from hot stack gases has led to investigation of the concept of a dry granular bed device used as a simultaneous SO2 sorber-fly ash collector for power station flue gases. In these devices, an SO2 sorber such as alkalized alumina would also act as the granular particles for collecting fly ash. At present, it is not possible to accurately predict dust collection performance on granular beds from aerosol filtration theory. A survey was undertaken to identify the most likely candidates among granular bed devices for power plant services. Most of the devices considered were panel filters, in which granular material filled a narrow vertical shaft. In the crossflow configuration as exemplified by the Dorfan-Impingo Filter or the Carnegie-Mellon shaft filter, the granules steadily fall through the shaft, carrying out with them accumulated dust, while the gas flows through the face of the panel in a crossflow manner. In the Squires designs, the granular material is held in the bed during treatment and intermittently removed from the panel by pneumatic or mechanical means. The Squires GSC design by virtue of appropriate internal spacers affords countercurrent gas-solid contacting. Little detailed data is available on the performance of the above sorber-dust collectors. Mathematical models for SO2 sorption on alkalized alumina were developed for counterflow, and fixed bed contactors. Calculations using these models indicated that there was no critical problem with regard to removal of SO2 under conditions which the developer of a particular device considered good for dust collection. Mechanical layouts were developed for the Squires GSC and crossflow designs to enable arrival at preliminary comparative cost estimates. Since, of the non-proprietary designs, neither the Squires nor the crossflow design has been tested to the extent necessary to demonstrate good mechanical operability, it is recommended that experimental work be undertaken on these two concepts. (Author abstract modified)

14270

Hart, S. J.

PROBLEMS OF GASEOUS EFFLUENTS. Preprint, Combustion Engineering Assoc., Hayes, Middx., Great Britain, 20p., May 2, 1969. (Presented at a Meeting of the Combustion Engineering Assoc., Manchester, March 25, 1969, Document 8603.)

A brief history of clean air and emissions control legislation in England is given, starting with the Alkali Works Regulation Act of 1863, which limited concentrations of hydrochloric acid in the exit gases of alkali processing, and culminating in the Clean Air Act of 1968. In this legislation, most plants are required to employ the 'best, practicable means' for emissions control; in addition, the Alkali Inspector sets presumptive limits as guidelines for enforcement. Since it is recognized that in practice, 100% control of pollutant emission cannot be achieved, adequate stack heights, calculated on the basis of a formula which takes into account wind speed, emission rate, and other relevant factors, are a complementary means of compliance. A general survey is presented of the technology of cleaning gas effluents by scrubbers and other methods, using fabric filters for metallurgical fumes and electrostatic precipitators for cement dust. In 1958, regulations were passed to cover very heavy smoke producers, including lime burning and certain ceramic industries, and particulate emissions classified as grit, dust, and fumes from such industrial sources as electricity production and metallurgical processing. The technical problems of emissions control in each of these industries are discussed in some detail. A record is included of the discussion of this paper by participants at the meeting at which it was presented.

14294

Ertl, D.

STATE AND FUTURE DEVELOPMENT OF ELECTRIC PRECIPITATORS FOR CENTRAL POWER STATIONS. (Stand und Entwicklung von Elektroentstaubern fuer Grosskraftwerke). Text in German. Mitt. Ver. Grosskesselbesitzer, 49(3):173-179, June 1969. 8 refs.

In the years 1964/65, only 29% of all electrostatic precipitators in the Federal Republic of Germany were designed to reach collection efficiencies of 99% or more; in 1966/67, the percentage rose to 50, and in 1968, 80% of the precipitators reached collection efficiencies of 99.4%. The fraction of precipitators with collection efficiencies of more than 99.5% rose in those years from 24 to 50%. Furthermore, in 1964/65, just 44% of the precipitators were designed for a residual dust concentration in the cleaned gas of less 100 mg/cu m; in 1966/67, 80% of the precipitators were designed to reach that goal. No new plants have been planned in the past two years which do not fulfill the Technical Directives for Clean Air Maintenance recommendations. As collecting electrodes, rolled sheet steel plates are mostly used, and once dust particles are collected, they are not carried away again by the gas flow. The length of the ionizing field has been changed from 6 to 12 m over the last ten years. In some cases, a length of 15 m has been selected. This tendency was not welcomed at first, but as studies of the dependence of collection efficiency on field length show, the latter has no influence whatever. With increasing size of the precipitator, new guide vanes in the form of perforated sheets were required to achieve uniform gas distribution over a large cross section with a minimum of ducts. To avoid bypass gas flow, devices which direct the gas flow repeatedly into the electric field are required.

14322

Hein, L. B., A. B. Phillips, and R. D. Young

RECOVERY OF SULFUR DIOXIDE FROM COAL COMBUSTION STACK GASES. Problems and Control of Air Pollution Frederick S. Mallette (ed.), New York, Reinhold, 1955, Chapt. 15, p. 155-169. (Also in: TVA, Wilson Dam, Alabama, Monthly Rept. 47-A, p. 63-74, March 1955. 12 refs).

Pilot-plant data was obtained with actual combustion gas from high-sulfur coal for evaluation of the process for the recovery of sulfur dioxide from dilute gases. The objective was to establish the effects of the operating variables that are important in evaluating the process. The major variables studied were the recirculation rate, pH, concentration of the scrubbing liquor, depth of packing, and gas velocity in the scrubber. The pilot plant consisted of equipment for burning pulverized coal, for cooling and humidifying the gas, and equipment for scrubbing the gas with an ammonium sulfite-bisulfite solution. The effect of recirculation rate on the recovery of sulfur dioxide showed increased recovery with increased recirculation rate up to 5 gal/ min and leveled off above this value. The recovery of sulfur dioxide decreased markedly below a pH of 6.3 and loss of ammonia became increasingly pronounced as the pH was raised. The liquor reciculation rate required to obtain a given recovery increased as the depth of packing was decreased. There was no significant change in the recovery of sulfur dioxide as a function of superficial gas velocity. Tests showed that the recovery of sulfur dioxide decreased and loss of ammonia increased as the concentration of the scrubbing liquor was increased. Data showed that the humidifer was effective in removing both dust and sulfur trioxide from the gas. Virtually all of the ammonia can be recovered from the scrubber exit gas by scrubbing with dilute ammonium sulfite-bisulfite solution in a second-stage tower. The results indicated that the ammonia scrubbing process can be used to recover large percentages of sulfur dioxide in stack gas and is operable over a fairly wide range of conditions, which should make it easy to control and should permit variation of the process for a specific installation.

14394

Tanaka, Shichinosuke, Takanao Niwa, Harumi Hirai, Tadami Imatake, Yoshio Harada, and Yoshiro Sakumoto

OPERATING EXPERIENCE AND CORROSION PREVENTIVE MEASURE OF RESIDUAL FUEL FIRING GAS TURBINE. (Mitsubishi Heavy Industries, Ltd., Tech. Rev., 5(3):196-207, Sept. 1968. 10 refs.

A 15 MW gas turbine is one of the few commercial gas turbines for base load power plants using grade C heavy oil and operating at an inlet temperature of 732 C. The risk of corrosion of turbine blades exists due to the corrosive nature of the fuel and the increase of radiant heat, resulting from the combustion of the oil, which causes a rise in the surface temperature of the blades. To prevent blade corrosion and to minimize the corrosive ash contained in the fuel, the fuel is washed with water and its water-soluble contents are removed with an emulsion breaker. Sodium in the fuel is reduced below 5 ppm and the ash quantity is halved by this treatment. A magnesium hydroxide inhibitor added to the fuel prevents corrosion by vanadium compounds. Turbine blades are further protected against corrosion by coating with Inconel 700 and Inconel X alloys. After 16,000 hrs of continuous operation, the average corrosion per blade is only 2.9 g. Deposits on the blade consist primarily of magnesium and vanadium, whose ratio varies according to the position of the blade. Deposits on the combustion basket, which could lead to its deformation, are composed of magnesium. Use of the magnesium hydroxide inhibitor is considered indispensible, but measures to achieve a more uniform distribution of magnesium are being studied.

14473

Ertl, D.

DEVELOPMENT OF DUST REMOVAL TECHNIQUES FOR WASTE GASES FROM STEAM GENERATORS. (Entwicklung der Entstaubungstechnik fuer Abgase aus Dampferzeugungsanlagen). Text in German. Tech. Mitt., 62(8):338-342, Aug. 1969. 10 refs.

For cleaning the waste gases from steam generators, dry electrostatic precipitators are almost exclusively used. Therefore, the operating prinicples and recent improvements of this type of dust collector are discussed. The newest type of collecting electrode is the CSA electrode with lengths up to 12 m. The plate-type electrodes have a thickness of 1.15 to 1.25 mm and a width of 763 mm. The isodyne electrode W 17 was developed as an ionizing electrode for operation with the CSA collection electrodes. For dusts with extremely high resistance, the band-shaped electrode B 5 is used. The fastening of these electrodes between the collection electrodes is particularly problematic. In the U. S., wires are pulled over the entire length of the field and fastened by weights, while in West Germany, frames are used for fastening the wires. With the latter method, spark erosion is avoided, but frames are very expensive. To obtain a uniform gas distribution, two to three perforated plates are installed in the inlet. Louvres are used for smaller inlets. To avoid by-pass flows, screens must be installed. In the past ten years, the field heights have increased from 6 to 12 m. Fears that the higher field length would have an adverse effect on collection efficiency lead to detailed studies of the relationship, but no negative influence could be found. Thin layers of dust on the electrodes with an electric impedence of 10 to the eleventh power ohm-cm reduced voltage and current considerably. A high operating voltage must be used in this case.

14546

Schwarz, O.

GENERAL VIEWPOINTS AND WORK BY THE HARD COAL MINING ENGINEERS ASSOCIATION ON DESULFURIZATION OF FLUE GASES. (Allgemeine Gesichtspunkte und Arbeiten des Steinkohlenbergbauvereins zur Schwefelabscheidung aus Rauchgasen). Text in German. Mitt. Ver. Grosskesselbesitzer, vol. 83:67-71, April 1963. 6 refs.

Hard coal contains sulfur in the form of organic sulfur (57%), pyrite (41%), and sulfate (2%). Of the hard coal mined in the Federal Republic of Germany, 93% is high-quality coal which can be sold, and 7% is ballast. The average sulfur content of all the coal mined in Germany amounts to 0.0144 kg/10,000 kcal. About 40% of the high-quality coal is used for coking, and 15 to 20% is exported. On the whole, it can be said that about 50% of the mined coal goes into combustion processes in which the sulfur is liberated and emitted to the atmosphere. Thus, out of the 140 million tons of coal mined annually, 705,000 tons of sulfur, 1,400,000 tons of SO2, 1,763,000 tons of SO3 and 2,155,000 tons of H2SO4 are emitted. Not all sulfur emissions qualify for desulfurization processes. Thus, the sulfur which can be gained from desulfurization is less than the amount emitted and is estimated as about 302,000 tons. The Federal Republic of Germany only has a market for sulfuric acid, which means that any desulfurization process has to take this into account. The Mining Engineers' Association presently operates experimental equipment with which problems such as the suitability of dry desulfurization for flue gases from coal-fired furnaces are being studied. The results are encouraging, but the equipment needs further development in order to be used in industry.

14566

Bienstock, D., J. H. Field, and J. G. Myers

PROCESS DEVELOPMENT IN REMOVING SULFUR DIOXIDE FROM HOT FLUE GASES. I. BENCHSCALE EXPERIMENTATION. Bureau of Mines, Pittsburgh, Pa., RI. 5735, 29p., 1961. 28 refs.

In bench-scale experiments, SO2 in 0.3% concentration was removed completely from a simulated flue gas without cooling the gas by using solids at flue gas temperatures common in power plant practice. A testing program was completed for screening solids for potential absorbents, adsorbents, and oxidation catalysts. The most active absorbents tested were the oxides of manganese, cobalt, copper, and alkalized alumina. Manganese oxide forms manganese sulfate by absorbing SO2. Upon hydrolysis of the sulfate with NaOH, active manganese oxide is recovered. Electrolysis of the filtrate produces NaOH for re-use in the process and H2SO4, H2, and 02 as byproducts. The spent alkalized alumina can be regenerated by reducing with producer gas at 600 C. Effluent gas containing hydrogen sulfide and carbonyl sulfide can be converted to elemental sulfur. After several absorption-regeneration cycles, there was no loss in activity or attrition of absorbent. Activated carbons, impregnated with metallic oxides, can remove SO2 at 130 C. At higher temperatures, oxidation of the carbon occurs. Adsorption of SO2 with molecular sieves is effective with sieves of pore diameters of 13 A. However, absorption is preferred to adsorption in the removal of SO2 from hot gases because of its greater efficiency. A potash-promoted vanadium pentoxide is very effective in converting SO2 to SO3 in the temperature range 300 to 400 C. Practically complete conversion of SO2 was obtained with a simulated flue gas at 365 C and at an hourly space velocity of 1050. Further engineering and cost studies will be undertaken to determine whether removal of SO2 by hot solids is feasible on an industrial scale. (Author conclusions modified)

14632

Haagen-Smit, A. J.

REMOVAL OF PARTICULATE AND GASEOUS CONTAMINANTS FROM POWER PLANT FLUE GASES. Air Pollution Control Assoc. Los Angeles West Coast Section, Proc. Tech. Meet. Air Pollution Control Assoc., West Coast Sect., 1st, Los Angeles, 1957, p. 102-110.

Methods for the removal of power plant flue gases are discussed. Two pilot plants in operation at the El Segundo Steam Station are working on the reduction of sulfur trioxide. One is an APRA unit working on the hot side of the air preheater, and the other is a Western Precipitation unit operating on the cold side of the air preheater. Many schemes for the removal of sulfur dioxide and nitrogen oxides are also being tested with flue gases pumped from one stack through the laboratory and out to the other stack. Through the loop in the flue gas line goes 100 cu ft/min of flue gas of relatively constant composition and temperature. Processes such as washing with water to remove SO2 were considered but were not economically feasible for large plants. Other processes, such as scrubbing with ammonium sulfite are not applicable in their present state to stack gases containing low concentrations of SO2 found from the combustion of oil. A dry scrubbing method using adsorption charcoals has promise in that charcoal has a remarkable ability to remove sulfur from large volumes of flue gas and can be reused. Since considerable adsorption of SO2 from flue gas is possible at 150 F, cooling the gas is not necessary. The desorption can be accomplished with steam, aqueous ammonia, or heating. In this procedure, SO2 is recovered in concentrations of 50-75% and NO or NO2 is also adsorbed. The breakthrough point for nitrogen oxides occurs much earlier than for SO2. Since the adsorption boundary of SO2 is sharply defined, there is the interesting possibility of eluting the two components separately at different column heights. A continuous flow system could then be adopted for each of the sections. For the control of nitrogen oxides, the possibility exists of decomposing them. Another approach consists of reduction with carbon, CO, hydrogen, or methane. Application of this method to the power plant problem is difficult, because flue gas contains excess oxygen which rapidly consumes available reducing agents. Nitrogen oxides removed by oxidation with HNO3 does not work at low temperatures. A great deal of research is needed to make these proposed schemes economically feasible.

14660

Herzog, G.

DESULFURIZATION OF FLUE GASES - PROBLEMS AND SOLUTIONS. (Die Entschwefelung von Rauchgasen - Probleme und Losungswege). Text in German. Energietechnik, 17(12):539-542, Dec. 1967. 9 refs.

The state of the art of desulfurization methods in East Germany is reviewed. The main emission sources for SO2 in East Germany are the power production plants and the sulfuric acid industry. In 1965, the power plants emitted a total of 685,000 tons of SO2. The sulfuric acid plants emitted about 17,500 tons of SO2 in 1966. No economic desulfurization method yet exists to cope with these enormous emission quantities. The wet processes based on absorption of SO2 by aqueous or alkaline suspensions or solutions have three specific disadvantages. The gases must be cooled prior to the desulfurization process, which leads to corrosion problems in the heat exchanger; there is a waste water problem; and the cold, wet gases have no thermal buoyancy. Due to such problems, industry has turned to dry methods in recent years. The Reinluft process for oxidation of SO2 to sulfuric acid over an activated carbon catalyst has been of prime interest, although it is not economical. A brief outline of the essential principles of this method is given. Oxidation of SO2 to SO3 and subsequent removal of the latter by condensation with water to form H2SO4 or by adsorption on activated coal is mentioned. Studies are presently underway in East Germany on the binding of SO2 to alkaline substances such as ash.

14707

Jelen, B.

DEVICES AGAINST DUST NUISANCES. (Zarizeni proti prasnosti). Text in Czech. Ochrana Ovzdusi, no. 3:33-41, 1969.

Fuels used for power production in Czechoslovakia have a high ash and sulfur content. They are contributing to pollution of the lower atmosphere, affecting the health of workers and the productivity of industrial enterprises. Early conversion to gaseous or liquid fuels is not foreseen, but fuel dusts can be substantially reduced by dust collectors. Efficient collectors exist, and more funds must be provided for their maintenance and for disposal of the harmful substances they collect. When equipment is properly maintained, these substances represent valuable raw materials that can be returned to the industrial process. Industrial works at Milevsko, Liberec, and Nove Mesto produce mechanical and wet collectors, electrostatic precipitators, filters, and accessories required for efficient operation. This equipment is described in detail, together with the operating parameters of each item. Further research and development in this field continues.

14730

Stites, J. G., Jr., W. R. Horlacher, Jr., J. L. Bachofer, Jr., and J. S. Bartman

SO2 CONVERSION. 3. REMOVING SO2 FROM FLUE GAS. Chem. Eng. Progr., 65(10):74-79, Oct. 1969.

A prototype plant to demonstrate the technical feasibility of a catalytic oxidation system for removing sulfur dioxide from flue gas, opened in 1967, using commercial-type equipment designed to treat 24,000 std cu ft/min; the system permits cleaning the catalyst from the converter beds without converter shutdown. All fly ash is effectively removed from the hot furnace gas with the combination mechanical separator and electrostatic precipitators. The operability of the dust collection system is outstanding; however, experience indicates that use of the less expensive pneumatic system would be satisfactory. The converter system provides conversions of SO2 to SO3 in excess of 90% as long as the proper temperature is maintained; conversion efficiency of 80% can still be achieved at 750 F. The flue gas, after enrichment with SO3, is cooled to just above the dew point in a two-step system involving first a high-level economizer and then a Ljungstrom air preheater. Over 99.5% of the very fine sulfuric acid mist particles are formed in the process of cooling SO3-enriched gas streams removed with a mist eliminator. The prototype CAT-OX unit is operated at a negative pressure. Motive force for the flue gas is an induced draft fan following the eliminator. Instrumentation, operations, maintenance, and economic considerations are briefly discussed.

14838

Borio, Richard W., Robert P. Hensel, Richard C. Ulmer, Hilary A. Grabowski, Edwin B. Wilson, and Joseph W. Leonard

THE CONTROL OF HIGH-TEMPERATURE FIRE-SIDE CORROSION IN UTILITY COAL-FIRED BOILERS. Combustion Engineering, Inc., Windsor, Conn., Research and Product Development, Contract 14-01-0001-485, OCR R&D Rept. 41, 224p., April 25, 1969. 35 refs.

Methods by which coal can be processed to reduce corrosion or damage to fireside surfaces of high-temperature boilers were investigated. Methods for reducing the amount of pollutants were determined. Certain relationships between coal composition and corrosion rates were indicated. Based on the data, the chief constituents affecting corrosion rate are alkalies, alkaline earth metals, iron, and sulfur. The combination of effects of sodium, potassium, alkaline earth metals, and iron made it possible to explain corrosion rates on most of the coals tested. A nomograph was constructed whereby the potential corrosiveness of a given coal can be determined. Also, amounts of neutrality limes and limestones to be added can be established from the nomograph. It also provides a tool by which preparation processes can be modified to reduce the corrosiveness of coal. These results provided the groundwork for a corrosion-reduction study of the entire system of operations, from the seam face where mining begins to the point of loading for shipment. Principle methods of corrosion reduction included analysis of the mining system, coal preparation, and coal additives and blending. To control both sulfur gas emissions and boiler corrosion, it is desirable to maintain an optimum balance between the sulfur level of the coal and the alkaline earth metals retained in the coal or added to the coal. Conventional cleaning using gravity techniques can remove most of the pyritic sulfur and thereby reduce the total sulfur by 50% or more. Such a reduction greatly reduces the sulfur but increases alkaline earth percentages as well. (Author abstract modified)

14891

Glenn, Richard A. and Robert D. Harris

LIBERATION OF PYRITE FROM STEAM COALS. J. Air Pollution Control Assoc., 12(8):388-395; 404, Aug. 1962. 2 refs.

The nature and mode of occurrence of pyrite in coal were studied in the laboratory as part of an effort to develop improved methods for reducing the amount of sulfur in coal prior to its being burned. Each of five high-sulfur bituminous coals were analyzed for forms of sulfur and size distribution of the pyrite particles. The major portion, by weight, of the pyrite in the samples was shown to exist as particles large enough to be readily separated once they are liberated. The experimantal pulverization of coals by impact-shearing, by impact, and by air jet impingement were carried out. Results indicate that liberation of the major portion of the pyritic matter and nonpyritic mineral matter may be accomplished by controlled pulverization to sizes coarser than that now obtained in modern pulverized coal-fired power plants. It was shown that during pulverization the pyrite tends to concentrate in the various particle-size fractions. The microscopic pyrite particles embedded in the coal substance tended to concentrate in the very fine fractions, below minus 200 mesh; the larger pyrite particles, that are associated with the mineral matter, concentrated in the greater-than-60-mesh fraction. Where the pyritic sulfur is mainly associated with mineral matter, there are good prospects of its removal by presently-available equipment. Removal of the pyritic grains embedded in the organic matter requires the development of improved equipment for processing coal in the minus 200 mesh size. (Author summary modified)

14981

REMOVAL OF SO2 FROM FLUE GAS. AVCO Missiles, Space, and Electronics Group, Wilmington, Mass., Final Report, 157p., Nov. 1, 1967. 10 refs. CFSTI: PB 177 492

The alkalized alumina for removing of SO2 from power plant flue gases was studied by developing process models for fluid bed and dispersed bed sorption systems. Using the process models, the economics of the two types of contactors were compared, and operating and capital costs were estimated. Preliminary calculations indicate that conditions may be obtained under which the process can be operated with only a small cost penalty. Potentially, with improvement in regeneration and sulfur recovery, the alkalized alumina will operate at a profit while removing 90%, or more, of the sulfur from the flue gas. The optimum operating conditions were determined by estimating the process cost as a function of sorbent loading. The kinetics of the sorption process were measured and found to be pore diffusion controlled over most of the possible range of sorbent loadings. The rate of sorption at sorbent loading greater than 2% SO2 is greatly enhanced by the presence of moisture in the flue gas. At 10% sorbent loading, the rate is over a 100 times as fast in the presence of 5-7% moisture as in the dry flue gas. A rate model describing the sorption process was developed. In the pore diffusion region, the model gives a good account of itself both in theory and in its ability to correlate data, and gives satisfactory description of the sorption rate at loadings exceeding 2% SO2. The rates of regeneration of spent sorbent were also measured at various levels of initial loading from less than 10% of saturation to almost complete saturation. Regeneration was found to increase with decreasing hydrogen pressure, and the percent thermal regeneration was found to decrease as the length of the sorption cycle increased. There was no measurable reduction in the time required for the sorbent to regenerate to constant weight as the gas composition was varied from pure hydrogen to pure carbon monoxide. It is concluded that reformed gases appear satisfactory as regenerating gases.

15031

Bovier, Ralph F.

SULFUR-SMOKE REMOVAL SYSTEM. Proc. Am. Power Conf., vol. 26: 138-144, 1964. (Presented at a Symposium on Air Pollution- Control Aspects.)

A new system for removing fly ash and sulfur dioxide from power plant stack emissions was tested in a pilot plant. Studies were based on the assumption that in full-scale practice a relatively high-sulfur content coal (about 3%) would be used, and that plant capacity would be about 1 million kw. The Sulfur-Smoke Removal System, (flow diagram given), is an adaptation of the contact catalytic process used in the manufacture of sulfuric acid, and consists of the oxidation of SO2 to the trioxide and condensation as sulfuric acid. In this application, the process varies from the conventional acid plant practice in that all sulfur values are removed by the most efficient mist collection system rather than the normal one in which H2SO4 is circulated. Almost 100% of the fly ash is removed by passing the flue gas through a mechanical dust collector after it leaves the boiler, and then through a high-temperature electrostatic precipitator. About 90% of the SO2 is removed and recovered at a concentration of about 70% sulfuric acid. An economic evaluation indicated that the process would meet all requirements of operating and economic feasibility.

15092

Nagai, Hirokazu

DESULFURIZATION OF EXHAUST GAS FROM COMBUSTION FURNACES. (Nensho haigasu datsuryu sohchi). Text in Japanese. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa Prefecture, Japan) Japanese Pat. Sho44-11764. 2p., May 29, 1969. (Appl. March 31, 1969, 1 claim).

The vanadium pentoxide catalyst used most frequently for oxidation of waste sulfur dioxide in the manufacture of sulfuric acid loses its activity by contact with water or low temperature steam. The danger of activity loss is greatest at the base of the stack, where exhaust gas temperature is lowest. The problem is solved according to this patent by providing bypass ducts above and below the catalyst layer. However, when the bypass ducts are closed to allow oxidation of the sulfur dioxide, the catalyst temperature is still too low to effect conversion, and it is not desirable to raise the temperature with a thermal shock of hot gas. For this problem, a duct carrying pre-heated air is brought through the catalyst layer so that the catalyst can be warmed before the bypass ducts are closed. This hot air duct may also be used to purge the catalyst between operations.

15148

Siegmund C. W. and E. H. Manny

QUALITY CHANGES OF THE FUEL OIL AT MORE STRINGENT LIMITATION OF THE SULFUR CONTENT. (Qualitaetsveraenderungen bei Heizoeleinfluss der Schwefelauflagen). Text in German. Oel Gasfeuerung, 14(9):874-82, 1969. 3 refs.

Limitations on sulfur oxides emissions primarily apply to power plants which emit 52% of the total sulfur oxides emissions. These emissions can be reduced either by the use of low-sulfur fuel or desulfurization of the waste gases. Low-sulfur fuels are obtained either from crude oil with low sulfur content or by desulfurization of high-sulfur crude oil. The low-sulfur crude oil contains paraffin which solidifies between 38 and 40 C so that a temperature of 50 to 55 C must be maintained to guarantee smooth flow through the pipe system of furnaces. If this high temperature cannot be maintained at all times, distillate fuel oil must be added. In this way, the viscosity and density of the fuel oil is decreased. As a consequence, lower preheating temperatures are required without impairing the atomization process. The main advantage of low-sulfur fuel oil is the low content of ash-forming substances and asphalt. Distillate fuel oil is practically ash free. Two methods are available for desulfurization of high-sulfur fuel oil, namely, catalysis and vacuum desulfurization. Selection of the method depends on the properties of the high-sulfur crude oil. Present regulations in New Jersey and New York require desulfurization to a residual sulfur content of 0.3%. In California, sulfur content is limited to 0.5% by weight. In general, the quality of low-sulfur fuel oil is better, though the costs are higher owing to the necessary desulfurization process. For desulfurization of emissions, alkaline additives or oxidation of SO2 to SO3 and conversion to sulfuric acid can be used.

15155

Kercher, Hermann

THE REDUCTION OF STACK EMISSIONS AT POWER PLANTS THROUGH DUST SEPARATION IN ELECTROSTATIC PRECIPITATORS. (Die Verminderung des Schornsteinauswurfs bei Kraftwerken durch elektrostatische Entstaubung). Text in German. Energie (Munich), 21(9):279-86, Sept. 1969. 11 refs.

After reviewing the legal limits (150 mg/standard cu m at new plants) set for dust emissions by power plants and various means for dust separation, e.g., cyclones, cloth filters, wet dust separators etc., attention is focused on the electrostatic precipitator. Primary factors which reduce the collection efficiency, and measures to avoid them, are discussed. The collection process in the electrostatic precipitator is theoretically expressed in the Deutsch formula, which is based on two presumptions: in each field cross section perpendicular to the main flow, the unprecipitated dust is uniformly distributed, and the dust precipitated on the collection electrodes is not reagitated. According to the Deutsch formula, the larger-sized unit has the higher collection efficiency and a low gas speed increases its efficiency. Adequate gas flow into the precipitator is also highly important. The gas must be ionizable. Pure nitrogen does not have this property, but O2, SO2 and H2O molecules are ionized easily. Higher gas temperature increases the mobility of the ions, but above 200 C the gas viscosity impairs the speed of particle movements. Dust particles with a high fraction of incombustible substance and very fine dust collector reduce efficiency, while uniform dust and gas distribution improves the performance of the precipitator. Shaking intervals should be chosen in agreement with the thickness of dust accumulating in the various sections of the collection electrodes. Backscattering, caused by high dust resistance, can also reduce the collection efficiency. The light extinction method of measuring dust resistance and dust concentration is briefly reviewed.

15240

Squires, Arthur M.

SYSTEM TO PROVIDE CLEAN POWER FROM RESIDUAL OIL. Preprint, Air Pollution Control Association, New York City, 30p., 1969. 14 refs. (Presented at the Air Pollution Control Assoc., Annual Meeting, 62nd, New York, June 1969, Paper 69-198.)

If the power industry should gear itself to accept the oil refiner's high-sulfur discards, the premium cost for low-sulfur oils to the small non-power user might be reduced by more than 40%. A plant is described to treat high-sulfur oils at an existing power station and to supply the station with sulfur-free fuels. The plant includes oil cracking, oil gasification, and product desulfurization steps. The latter step employs calcined dolomite, and sulfur is recovered for sale in its elemental form. Nearly half of the fuel products are liquid or solid and can be stored. For a customer station having a load factor of 70%, the station could be turned down to 37% of its rating before the clean fuel plant need be cut back. The scheme is nearly a break-even proposition from the energy standpoint, and there is a good possibility that its adoption could reduce the cost of electricity below present level. (Author abstract)

15244

Titov, N. G. and L. A. Borozdina

ON THE RELEASE OF SULFUR OXIDES INTO THE AIR DURING COMBUSTION OF SOLID FUELS. (K voprosu o vydelenii v vozdukh sernistykh gazov pri szhiganii tverdykh topliv). Text in Russian. Khim. Tverd. Topl., no. 5:100-107, 1968. 4 refs.

Study of the combustion of sulfur-containing coals from various sources has revealed the need for taking into account the composition and properties of the organic and mineral portions of the fuel. It was found that with fuels containing calcium and magnesium humates, the initial combustion stage is accompanied by decomposition of the humates with the appearance of calcium and magnesium oxides which readily combine with sulfur oxides formed during the burn-out of pyrite and organic sulfur compounds, to yield non-volatile sulfates. Naturally- occurring calcium and magnesium present in the coal in the form of gypsum, calcite, ferrocalcite, dolomite, etc., are not available for such reaction, since formation of their oxides takes place at too-high temperatures. One means of combating pollution by sulfurous products of combustion might be joint combustion with appropriate quantities of lowland fuels and earthy lignite which usually contain significant quantities of calcium and magnesium humates.

15251

Nishimura, Hiroshi and Iwao Osoegawa

RECENT UTILIZATION OF FLY-ASH IN JAPAN. (Wagakuni niokeru furaiasshu riyo no genjo). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 47(490):98-106, Feb. 1969. (1968 Printed in error.) 8 refs.

The fly ash recovered by electrostatic precipitators from dry bottom boilers, is primarily utilized for fly ash cement and pozzolan material. In 1966, 645,162 tons of fly ash was used for this purpose in Japan. In addition, the fly ash recovered by multi-cyclones is used as a fertilizer called green ash. The fly ash utilized for this purpose amounted to 81,236 tons in 1966. The coarse ash from a bottom economizer and air heater is utilized as a road-base stabilizer called coal sand. Coal sands from several electric power stations were subjected to various tests of particle size, compactness, compressive strength, and CBR. The mechanical properties of the coal sand differed from station to station, but all of them were useable. During the past two years, 100,000 cu m of coal sand were supplied to the Kyushu district. Recovery of vanadium on a boiler-tube scale began in 1966, and 50 tons of vanadium were recovered in half a year. The figure will be increased when the recovery of vanadium from the dust collector, a process now under study, will be realized on an economical scale.

15284

Squires, Arthur M., Robert A. Graff, and Melvyn Pell

DESULFURIZATION OF FUELS WITH CALCINED DOLOMITE. I. INTRODUCTION AND FIRST KINETIC RESULTS. Preprint, American Institute of Chemical Engineers, New York, N. Y., 27p., 1969. 32 refs. (Presented at the Am. Inst. Chem. Engrs. Annual Meeting, 62nd, Washington, D. C. 1969, Paper 12C)

Gasification with air and carbonization or cracking serve to release sulfur from fuels in the form of H2S. Both fully calcined and half-calcined dolomite have the power to accept sulfur from H2S according to the reactions (1) (CaO + MgO) + H2S equal (CaS + MgO) + H2O and (2) (CaCO3 + MgO) + H2S equal (CaS + MgO) + H2O + CO2; (3) is the reverse of reaction (2) to regenerate half-calcined dolomite and obtain H2S in concentrated form. The thermodynamic conditions of temperature and pressure of each reaction are discussed. To illustrate the technical possibilities, a representative clean power system for treating coal and producing by-product sulfur is described, in which a unitary operation can carbonize coal and desulfurize the products by the action of hydrogen and a solid acceptor for sulfur. The fuel-processing vessel operates at 21 atm and houses three fluidized-solids zones: a 'hydrocarbonizing' zone at 760 C, which converts finely ground coal into gaseous products and coke pellets; a desulfurizing zone also at 760 C, for removing sulfur both from gaseous products of carbonization and from coke by the action of H_2 at 5.8 atm and calcined dolomite acting as a sulfur acceptor; and a calcination zone at about 950 C, for decomposing $CaCO_3$. Each of these zones is described. Several advantages of the system are given: hydrocarbonization and desulfurization occur nearly simultaneously; H_2 arises autogenously, and a separate H_2 facility is therefore not needed; a single processing vessel can handle an outstandingly large throughput of coal; thermal efficiency of the operation is high enough to avoid any loss in power generating efficiency, and the coke pellets are ideal for fluidized-bed combustion by two current techniques. First kinetic results for reaction (1) above, conducted on spheres 5 to 8 mm in diameter are discussed, and a reactor for obtaining differential rate data by following the change in weight of a sample of dolomite stone is described.

15357

PROCEDURE FOR DESULFURIZATION OF GASES. (Procede pour desulfurer les gaz). Text in French. (Farbenindustrie (I. G.) A.-G., Germany) French Pat. 846,165. 4p., Sept. 11, 1939. (Appl. Nov. 17, 1938, 4 claims).

The invention concerns a procedure for elimination of hydrogen sulfide and/or sulfur dioxide present in gases by bringing these gases into contact with wet lignite or with wet solid substances produced from lignite. The sulfur-containing substances are gasified or distilled at a low temperature jointly with another fuel. These gases are treated with aqueous suspensions of powders prepared from lignite or obtained from it in the course of its treatment. The gases may be submitted to further purification provided their H_2S content is relatively low.

15358

Mache, A. and R. Authier

CONVERSION OF THE STEAM ELECTRIC GENERATORS OF THE ARRIGHI CENTRAL STATION TO FUEL OIL. (Transformation au mazout des generateurs de vapeur de la centrale Arrighi). Text in French. Le Genie Civil, 142(5):82-104, March 1, 1965. 1 ref.

An extensive account is given of the history of the Arrighi steam electro-generating station and of the engineering and economic aspects of its conversions from powdered coal to natural gas and, finally, to fuel oil. Operational characteristics of the latest installations are given, and the environmental aspect of the station is discussed at some length. During a total of two years before and after the conversion to fuel oil, continuous measurements of the SO_2 content of the air were carried out at three locations in the vicinity of the station by bubbling filtered air through water at a known rate and determining the rate of formation of H_2SO_4 in the latter. In the winter, domestic emissions of SO_2 were found to exceed greatly those of the station, which uses fuel oil with 0.35 to 0.96% S in the winter and with 2.25 to 3.0% S in summer. To lower the sulfur content of the flue gases, a built-in apparatus is used to inject powdered dolomite or magnesium carbonate into the combustion chambers of the boiler furnaces and powdered dolomite only into the combustion gas ducts. The dolomite powder dosage is 1 kg/ton of fuel oil per % S in the oil. These injections were found to have beneficial secondary effects as well. By rebuilding the stacks higher and slimmer and by elimination of reheaters, the stack exit speed of the flue gas was raised from 6 to 20 m/sec and its temperature from 120 to 185 C, thereby raising the altitude of the flue gas plume 100 m above its pre-conversion value and thus greatly improving the pattern of flue gas dispersion in the atmosphere.

15378

PROCEDURE FOR PURIFICATION OF COMBUSTION GASES. (Procede pour l'epuration des gaz de combustion). Text in French. (Societe des Forges et Chantiers de la Mediterranee, France) French Pat. 1,399,747. 3p., May 21, 1965. (Appl. April 10, 1964, 2 claims).

The invention concerns a procedure for purification of combustion gases, particularly of coal or fuel oil-fired boilers, by means of a heat exchanger made of granulated material and placed in the combustion gas duct. The granulated material may itself contain substances which react with SO_2 and SO_3 contained in the combustion gas. Such as red bauxite slurry after hardening, or it may be in the form of an inert porous substance which adsorbs SO_2 and SO_3, such as kieselguhr. The surface of the grains of this material removes the film of acid formed by the reaction of SO_2 and SO_3 with water when the combustion gas temperature has been lowered sufficiently.

15436

Teller, Aaron J.

RECOVERY OF SULFUR OXIDES FROM STACK GASES. Preprint, Metropolitan Engineers Council on Air Resources, New York, N. Y., 11p., 1967. (Presented at the Symposium of the Metropolitan Engineers Council on Air Resources, New York City, Oct. 1967.)

The following problems are associated with sulfur oxides recovery: effect and handling of particulates generally in the micron submicron range following a precipitator or existing in oil burning effluents; contaminating effects of sulfur trioxide particulates; wide variation in gas loading with as much as 6:1 turndown; and restricted availability of land in proximity to power plants. The following criteria should be used for the selection of a recovery process: stability of the chemical or physical recovery system to the submicron particulates and sulfur trioxide; stability of the adsorption or catalytic material; turndown capability of the system; and land area required by the recovery system. Effective recovery of sulfur dioxide in a non-regenerative form can be achieved with lime scrubbing; however, lime feed must be approximately 125% of stoichiometric amount in order to achieve 98% recovery, creating a solids disposal problem. Another non-regenerative process consists of a dry reaction of sulfur dioxide, oxygen, and lime at temperatures in the 1500 to 2000 F range, with an expected 25% recovery; the restrictive factor is the contact time. Regenerative processes offer the greatest potential for economic recovery and a preservation of the natural resource of sulfur and are classified as follows: alkalized alumina adsorption; direct catalytic conversion to sulfuric acid; char adsorption; absorption accompanied by chemical reaction; and reversible chromatographic separation.

15489

Rees, R. L.

PRESENT PERFORMANCE AND SCOPE FOR IMPROVEMENT IN POWER - STATION FLUE - GAS WASHING EQUIPMENT FOR THE REMOVAL OF SULPHUR DIOXIDE. Institute of Mechanical Engineering, London, Proc. Conf. Mech. Engrs. Contrib. Clean Air, London, 1957, p. 34-41. 16 refs. (Feb. 19-21.)

The methods of removing sulfur dioxide from power-station flue gases were reviewed. The Battersea effluent process used at Battersea and Bankside power stations, removes up to 95% of the sulfur dioxide. The Howden-I.C.I. cyclic lime process was formerly used at Tir John and Fulham power stations. The Fulham-Simon-Carves process for making ammonium sulfate and sulfur by direct reaction of gas-works ammonia liquor with flue gases is now undergoing pilot plant trials at Nottingham power station. Other ammonia processes that were developed at Trail Smelter are being considered for use in the United States of America by the Tennessee Valley Authority. The removal of pyrites from coal is not generally feasible in Britain because of the very small size of the pyrites aggregates. The dry removal of sulfur dioxide from flue gases, which would not entail the cooling of the gas (a most serious defect of all flue-gas- washing processes because it causes the discharged gas to sink rather than rise), is again being studied, but presents formidable obstacles in engineering and chemical engineering design. (Author abstract modified)

15516

Nelson, H. W., R. E. Schuler, M. J. Shilhan, and R. B. Engdahl

STUDY OF THE IDENTIFICATION AND ASSESSMENT OF POTENTIAL MARKETS FOR CHARS FROM COAL PROCESSING SYSTEMS. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Contract 14-01-0001-1190, Rept. 44, 74p., 1969. 29 refs. CFSTI: PB 182 966

The potential markets for chars derived from coal-processing conversion systems were identified and assessed. The chars showed considerable variations in their contents of ash, sulfur, and volatile matter. The importance of concern for air pollution is reflected in the choice of fuels used in power plants and the means adopted to alleviate the emission of sulfur oxides from the stack. Awareness of this problem led to research on methods of desulfurizing char. A method was suggested involving the contacting of a mixture of char and dolomite with hydrogen in a rotary bed. The dolomite is regenerated and elemental sulfur is recovered as a by-product. Plants having access to medium- or high-sulfur coals will be forced to employ means of removing the sulfur oxide content of combustion gases before they are discharged to the atmosphere. Injection of limestone into the furnace followed by wet scrubbing is promising but costly. Calculations showed that a desulfurized char has a premium value when compared with generating costs using coal with the added costs of removing sulfur oxides from the stack gases. If the desulfurization process is shown to bear costs, there would be a large market in the Midwest and East for the desulfurized char. In combination with its lack of moisture and hydrogen, the desulfurized char should show savings in generating costs and thus be a preferred fuel. Because of high contents of ash and sulfur and the relatively fine size of the char, which leads to excessive stack losses, it was concluded that there is little prospect of finding a market for char in the manufacture of calcium carbide. An assessment of the potential usefulness of char as a component of a blend of coals used in coke ovens for the production of metallurgical coke showed that the high sulfur and ash contents would make them unacceptable for use in blends.

15532

Shale, C. C., W. S. Bowie, J. H. Holden, and G. R. Strimbeck

CHARACTERISTICS OF POSITIVE CORONA FOR ELECTRICAL PRECIPITATION AT HIGH TEMPERATURES AND PRESSURES. Bureau of Mines, Morgantown, W. Va., Morgantown Coal Research Center, RI 6397, 16p., 1964. 20 refs.

The Bureau of Mines is studying the feasibility of electrical precipitation for removing entrained solids from gases at high temperatures and pressures: this method, if applied to new processes, could open new markets for coal. However, the highest known combination of temperature and pressure for which commercial equipment is available is 600 F and 2 atm. Consequently, a bench-scale precipitator was used to study the characteristics of positive corona for precipitation under unusual conditions of temperature and pressures. Electrical characteristics of positive corona are presented for air in a 2-inch-diameter electrostatic precipitator operating under dynamic conditions at 600 to 1500 F and 0 to 80 psig. Results show that current-voltage relationships depend solely on air density. Comparison of data on positive corona with previously published data on negative corona demonstrates a higher sparkover voltage and a wider range of operability for positive corona at temperatures above 375 F. The possibility of achieving higher voltages with positive polarity as indicated by these experiments implies several advantages for the use of positive corona in precipitators to allow better removal of suspended material from hot gases. Based on the physics of an ion in an electrical field, a theoretical equation is derived to define current-voltage characteristics of positive corona in terms of air density. Constants for the equation are evaluated from test data. Calculated current-voltage values at different air densities agree reasonably well with experimental data.

15543

Shale, C. C. and G. E. Fasching

OPERATING CHARACTERISTICS OF A HIGH-TEMPERATURE ELECTROSTATIC PRECIPITATOR. Bureau of Mines, Morgantown, W. Va., Morgantown Coal Research Center, RI 7276, 19p., July 1969. 19 refs. CFSTI: PB 185549

A pilot-scale semicommercial high-temperature precipitator and adjunct equipment for removing solids from coal process gases are described, and operating characteristics at 1470 F and 80 psig are presented for both positive and negative polarity. The high-temperature electrical characteristics of negative corona in a bundle of 6-inch tubes are shown to be similar to those found previously for a single 2-inch tube. Although the negative electrical field in a precipitator almost completely deteriorates at high temperature and low density, high gas density provides an adequate field to accomplish effective gas cleanup in a precipitator at this temperature. Dust removal efficiency in the negative corona ranges 91-96% at maximum tolerable voltage (36.5 kv) prior to sparking; power input averages 6.4 kva. Removal efficiency in the positive corona is only 75-77% even at 54 kv is almost 50% higher than the maximum utilized in the negative corona; power input is less than 2.0 kva. Input power-removal efficiency relationships at high temperature compare favorably with those found in industrial precipitators operating at much lower temperatures. Voltages well above the maximum utilized might be used at these operating conditions to improve the relative effectiveness of positive corona for cleaning ash laden gases. The use of positive polarity in a precipitator for cleaning hot gases appears to be limited to the voltage at which localized flares are generated under given operating conditions. No apparent insurmountable problems were encountered in operating the electrostatic precipitator at 1470 F and 80 psig. Thermal misalignement of the tube sheet in addition to difficulties with the yoke and the tube rapper, appear to be mechanical problems that can be eliminated by design modifications.

15544

Hangebrauck, Robert P. and George D. Kittredge

THE ROLE OF COMBUSTION RESEARCH IN AIR POLLUTION CONTROL. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 17p., Sept. 1969. 10 refs. (Presented at the Combustion Institute, Eastern States Section, Technical Meeting, Morgantown, W. Va., 1969.)

Research and development projects aimed at developing technology for minimizing emissions from combustion processes are reviewed. The projects are discussed in relation to specific pollutants and sources, which include electric power production, industrial and residential combustion, refuse combustion, and motor vehicle sources. For stationary sources of pollution, fluid bed combustion may provide an economical system of heat generation for reducing emissions of sulfur oxides, and perhaps nitrogen oxides, from fossil-fuel combustion by steam-electric power stations. Research is in progress on models for predicting nitrogen fixation; these models would be used in design of burners and boilers for low output of NOx. Another possibility for controlling power generating systems involves integrating new power cycles with fuel cleaning. Improved burner and furnace designs offer opportunities for reducing pollution from sources other than power generators. Current development work in incineration could lead to both lower pollution levels and better use of resources by heat recovery. For motor vehicle sources of pollution, the possibilities of control are diverse. Industry is concentrating chiefly on enhancing combustion in spark-ignition engines by improving fuel atomization, air-fuel mixing, and distribution. Also under study are changes in fuel composition, high-temperature exhaust system reactors, and exhaust gas recirculation for NOx control. Elsewhere, alternative types of low-emission propulsion system, in particular Rankine cycle systems, are under development. Control techniques for diesel engines are directed toward improving fuels and engine designs to eliminate smoke and odor. Finally, projects for reducing emissions from aircraft are underway.

15560

Council for Scientific and Industrial Research, Pretoria (South Africa), Air Pollution Research Group

HOW TO OBTAIN HIGH STEAMING RATES FROM VERTICAL BOILERS FIRED WITH ANTHRACITE. CSIR Res. Rept. 249, 4p., 1966.

Simple modifications were made in a vertical boiler installation in an effort to determine whether a high steaming rate was possible using anthracite instead of bituminous coal with the object of reducing smoke production. A complete energy balance for the boiler was obtained. Using bituminous coal in the experimental boiler, the steaming rate achieved by an experienced stoker was 14% more than that achieved by an inexperienced man. When anthracite coal was used and the stoker was the same inexperienced man, the stack gas flow dropped by 51%, and the steaming rate dropped by 25%. When a forced draught was used with anthracite to bring the stack-gas flow to about the same as it was when bituminous coal was used, the steaming rate was 56% higher than when anthracite was used without a forced draught and 17% higher than when bituminous coal was used. The highest efficiency was obtained when anthracite was used with a natural draught. The flow rate of gases through the boiler is such that some combustion takes place in the stack, thus causing a heat loss. Worthwhile savings could be achieved if a simple economizer were installed above the boiler. This boiler can be applied in industry if the draught is increased so as to make the stack-gas flow rate approximately the same as when bituminous coal is used.

15572

Zawadzki, E. A.

LIMESTONE-BASED PROCESSES FOR CONTROLLING SULFUR DIOXIDE EMISSIONS. Preprint, Illinois Mining Inst., Springfield, 6p., 1969. (Presented at the Illinois Mining Institute Annual Meeting, Springfield, Oct. 9-10, 1969.)

A limestone-based process for control of sulfur dioxide emissions from power plants, based on dry injection, is to be tested at TVA's Shawnee power plant under varying conditions of limestone dispersion, injection temperature, stoichiometry, limestone type, and particle size. A wet scrubbing process will also be tested in the same boiler with some of the same components. Both processes are considered as prime candidates for control of sulfur dioxide emissions due to their versatility and their relatively low capital and operating costs. The wet limestone process will present data on the following: waste disposal and water pollution potential; loss of plume buoyancy; corrosion, solids deposition, and process maintenance; process chemistry and kinetics; and scrubber type. The dry limestone process can be applied to all boilers of 200 MW or lower capacity and less than 30 years old; average capital costs will range from $5 to $8 per kilowatt (1969), and operating costs will average $1.00 to $1.50 per ton of coal. The wet limestone process is applicable to all existing boilers 20 years old or younger; capital costs will range from $9 to $12 per kilowatt, and average operating costs will range from $0.75 to $1.50 per ton of coal. (Author abstract modified)

15616

Vadot, L., P. Belle and A. Inard

INVESTIGATION OF THE DISPERSAL OF SMOKE AND DETERMINATION OF THE HEIGHT OF A CHIMNEY. (Etude de la diffusion des fumees et determination de la hauteur d'une cheminee). Text in French. Pollut. Atmos. (Paris), 11(43):131-142, July-Sept. 1969.

The process of smoke dispersal in the atmosphere as emitted from the chimney of a central heating plant to be located at the edge of the ZUP area near Grenoble (France) was studied in the design stages. A hydrodynamic channel was used for diffusion studies as well as a 1:1000 scale model of the plant with a chimney and the larger buildings in the neighborhood. In the analogue model tests, the relative density of atmospheric air was represented by the concentration of NaCl in the water of the channel; smoke outlet temperatures of 100 or 200 C corresponded to NaCl concentrations of 50 or 150 g/l, respectively, of the water injected through the model chimney at the speed of 5 cm/sec. The speed of the water in the channel could be varied between 5 and 25 cm/sec., corresponding to wind speeds between 2.34 and 11.7 m/sec. The height of the model chimney could be varied between 3 and 10 cm. Three cases of smoke dispersal were studied above a flat terrain; in the presence of building on the ZUP; and in an atmosphere with a stable stratification. A total of 32 tests were made and many photographs of the simulated smoke plume under the different test conditions which were used in the test evaluation are shown. On the basis of these tests and other studies, a chimney height of about 75 m, a minimum outlet speed of 15 m/sec and an outlet temperature of the order of 200 C was recommended.

15665

Akbrut, A. I., I. Ya. Vinnik, A. I. Gitsarev, and G. A. Davidovskiy

TESTING THE FIRST ASH-COLLECTING ASSEMBLY WITH A VENTURI SCRUBBER. (Ispytaniye pervoy zoloulavlivayushchey ustanovki so skrubberom Venturi). Text in Russian. Elektr. St. (Moscow), 3(5):30-33, May 1969. 4 refs.

The Ural Branch of the ORGRES (State Trust for the Organization and Rationalization of Regional Electrostations and Networks) developed and put in operation (in April 1967 at the Verkhne-Tagil'sk State Regional Electrostation) the first industrial ash-collecting assembly with a venturi scrubber. This assembly has a high efficiency and reliability, assuring a stable 97% removal with an overall hydraulic resistance of 63 126 kg/sq m and a specific water consumption of 130 kg/1000 cu m (STP). Test operation indicates that this assembly is superior to multiple rod grids. For boiler installations designed for wet removal of ash from flue gases, the use of a venturi scrubber is one practical approach to increasing the efficiency of ash removal.

156920

Hasebe, S. Takeshi Tsunemoto, Kenjiro Takeshita, and Seiji Arita

DESULFURIZATION OF COALS IN COKING PROCESS. (Sekitan no kokusuka katei ni okeru datsuryu). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 48(512):892-898, Dec. 20, 1969. 8 refs.

In carbonizing coal at high temperatures, 50 to 90% of the sulfur content remains intact. The remaining content of inorganic sulfur is 62 to 66% and that of organic sulfur, 45 to 75%. Inorganic sulfur can be eliminated to a considerable extent by coking coal, but the elimination of organic sulfur is extremely difficult. Several experiments were conducted using Miike and Matsushima mine coals. Since the most suitable temperature for desulfurizing coal is 400 to 600 C, an effective desulfurizing agent and catalyst in this temperature region was sought. The suitable temperature for the desulfurization using hydrogen gas was about 800 C, above which the bonding of sulfur with coal became a great problem. Active hydrogen was supposed to be more effective than the molecular hydrogen. Carbonization of coal in the presence of tetraline, isopropyl alcohol, or cyclohexane as a source of active hydrogen was examined. Tetraline was more effective than hydrogen gas in the temperature region from 500 to 600 C. After transforming organic sulfur to pyrite sulfur in the presence of the compound, sulfur was removed by thermal decomposition. Carbonization with some inorganic compounds other than iron compounds was examined. Strong bases such as potassium hydroxide and sodium hydroxide can remove the sulfur, but their unfavorable effects on the gain and quality of coal prevent their utilization. Calcium hydroxide increases the sulfur content of coal obtained by fixing the sulfur as sulfur compounds, which can not be removed by washing with water or acid.

15693

Mukai, Shigeru, Yuriko Araki, Masaharu Konishi, and Keiichiro Otomura

DESULPHURIZATION OF COAL WITH SOME OXIDIZING REAGENTS (I). DESULPHURIZATION BY THE TREATMENT WITH CHLORINE GAS AND HYDROGEN PEROXIDE. (Sankazai ni yoru sekitan no datsuryu (I). Enso gasu oyobi kasankasuiso sui ni yoru datsuru). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 48(512):905-911, Dec. 20, 1969. 4 refs.

Desulfurization of coal has been investigated for many years, but no methods have been developed for industrial use. They have been studied mainly in the process of carbonization. The desulfurization method was examined at room temperature before carbonization. The conventional coal preparation technique is insufficient to reduce the sulfur content of bituminous coal, which has a high sulfur content. Desulfurization of Oshima and Ikeshima mine coals by chlorine treatment was attempted. Coal particles were suspended in water, and chlorine gas was introduced into this suspension for 0.5-6 hours. The sulfur content of Oshima mine coal containing 2.16% of sulfur decreased to 1.22%; the sulfur content of Ikeshima mine coal containing 2.58% of sulfur decreased to 1.82%. The desulfurization rate of Oshima mine coal was 42% and Ikeshima mine coal, 30%. The elimination rate of inorganic sulfur of Oshima mine coal was 95% and Ikeshima mine coal, 70%. Inorganic sulfur in coal is practically eliminated by treating with chlorine. Reduction of organic sulfur of Oshima mine coal was 13% and Ikeshima mine coal, 20%. After carbonizing the coal treated with chlorine, the sulfur content of Oshima mine coal became 0.8% and Ikeshima mine coal, 1.2%. The total desulfurization rate of Oshima mine coal was 63% and Ikeshima mine coal, 53%. Unfortunately, however, the coal treated with chlorine gas showed an unfavorable effect on the caking property. This difficulty was solved to some extent by adding some amounts of pitch to the chlorine-treated coal. Desulfurization by treating with the aqueous solution of 3% hydrogen peroxide was also examined. Coal particles were suspended in the aqueous solution of hydrogen peroxide. Desulfurization rate of Yotsuyama mine coal was about 30% and Akabira mine coal, about 30%. Inorganic sulfur was practically eliminated. Caking property did not decrease by treating with hydrogen peroxide.

15738

Squires, Arthur M.

CONTROL OF SULFUR DIOXIDE IN THE EXHAUST GASES FROM THERMOELECTRIC PLANTS. (Il controllo dell-'anidride solforosa negli scarichi gassosi della centrali termoelettriche). Text in Italian. Acqua Ind., 9(52):13-15, 17-23, 1967.

Construction of nuclear power plants will not provide immediate relief from the problem of controlling sulfur emissions from conventional plants, since construction of high-efficiency plants cannot begin until about 1985. Use of coal and hydrocarbon fuel oils naturally low in sulfur is impractical due to inadequate supplies of these materials. Desulfurizing fuel oil to 1% content costs about 25 cents per million calories, not allowing for profits from sale of by-products. Six desulfurizing plants in Japan will have a combined output of 187,500 barrels/day. The Japanese goal is to reduce sulfur content to 1.7% by 1969 and later to 1.1%. The most satisfactory coal desulfurization process is sifting to remove pyrite particles. Semicoke is partially desulfurized with hydrogen, the H2S being trapped by an acceptor such as MnO2, lime, or dolomite, from which SO2 is then removed as a gas. Reduction from 3% to 0.3% sulfur is estimated to cost 10 cents/ton or 1-1/2 cents/million calories. Recovered sulfur is worth 57 cents per ton of semicoke treated. However, large power plants might find exhaust-treatment methods more economical.

15841

Atsukawa, M., Y. Mizumoto, and M. Tsuda

REMOVAL OF SULFUR DIOXIDE GAS BY FERRIC HYDROXIDE. (Sanka-yuo gan'yu gasu no suisanka-tetsu niyoru shori-hoho). Text in Japanese. (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) Japanese Pat. Sho43-11648. 3p., May 16, 1968. (Appl. Feb. 23, 1962, claims not given).

Sulfur dioxide from the exhaust gas of industrial plants, especially of steam power plants, is collected by the use of ferric hydroxide aerosol with formation of ferric sulfate which is then converted by Mn203 into the ferric hydroxide to be recycled for the collection of SO2. The temperature of the SO2 which passes the collection hearth is between 100 and 300 C and it contacts the aerosol for 1.03 sec. The collection efficiency in this process is 97.3% and the sulfates produced during the procedure are changed into useful by-products. The gas exhausted after this procedure includes no humidity, and there is no need of a tall chimney to prevent air pollution. Thus, this method is most convenient and economical.

15844

Atsukawa, M., K. Nishimoto, and Y. Mizumoto

REMOVAL OF SULFUR DIOXIDE GAS BY MANGANESE OXY-HYDROXIDE. (Sanka-yuo gan'yu gasu no okishi-suisanka mangan niyoru shori-hoho). Text in Japanese. (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) Japanese Pat. Sho42-14712. 4p., Aug. 17, 1967. (Appl. Dec. 27, 1963, claims not given).

Manganese oxy-hydroxide (MnO(OH)) is used as an absorbent to remove sulfur dioxide from the exhaust gas of sulfuric acid factories, metal refineries, or steam power plants. The absorbent MnO(OH) is either sprayed as a mixture with manganese sulfate (wet process) into the exhaust gas or is placed in a bed as granules or powder while the exhaust gas passes over it (dry process). The temperature required for reaction is 55 C in the wet process and 150 C in the dry process. The SO2 removal efficiency is 97.2% in the former process and higher than 99% in the latter process. The manganous sulfate obtained in these processes is later converted to MnO(OH) by adding ammonia and oxygen within a glass cylinder. The ammonium sulfate obtained here may be later converted to ammonia by adding CaO or Ca(OH)2. Thus, MnO(OH) and ammonia can be reused in this procedure, making it one of the most convenient and economical processes for removing SO2 from the exhaust gas of industrial plants.

15902

Jaeger, Walter and Ashutosh R. Majumdar

REMOVING SO2 FROM STACK EMISSIONS. Nat. Eng., 73(11):16-18, Nov. 1969.

A new wet scrubbing process for the simultaneous removal of SO2 and fly ash from the tail gas of power plants is based on the use of a separator in which gases are intensively mixed with a water alkaline solution, distributed into very narrow layers, and then subjected to a high linear acceleration followed by deceleration. The acceleration and deceleration steps break down high surface tension between particles, making it possible for the rinse liquid to pick up particulate matter. The enriched rinse liquid, which is recycled through a settling tank, becomes saturated with fly ash that is removed by vacuum filtration or other separation methods. Part of the fly ash and 60-70% of the SO2 are absorbed in a packed cooling tower placed in front of the separator. The remaining SO2 is washed out of the separator by the rinse liquid. The main absorption process is the conversion of sulfite to bisulfite. Absorption with ammonia is recommended since ammonium sulfite can be easily oxided to salable ammonium sulfate.

15913

Pinaev, V. A. and G. K. Krushinskaya

SORPTION OF SULFUR DIOXIDE BY SEMICOKES MADE BY LOW-TEMPERATURE CARBONIZATION OF BROWN COAL. J. Appl. Chem. USSR (English translation from Russian of: Zh. Prikl. Khim.), 41(12):2449-2451, Dec. 1968. 6 refs.

Experiments were carried out to determine the ability of semicokes obtained by carbonization of brown coal to remove sulfur dioxide from gas streams. At 120 deg and below the sorptive capacity of the semicokes for SO2 in an unhumidified gas stream was 1.0-1.2 wt%. When the gas stream was humidified, the capacity of the brown coal semicokes for SO2 was approximately 2.3-2.7 wt%. Adsorption of SO2 was accompanied by adsorption of water vapor, indicating that the sorption capacity of semicoke is increased in the presence of water vapor, which ensures formation of H2SO4 on the adsorbent surface. Semicokes with a low sulfur content were identified in carbonizations carried out at 500-520 deg. Cokes with initial sulfur contents of 0.2 and 0.3% had sorptive capacities of 3.5 and 4.0 wt%, respectively.

15933

POLLUTION-ABATEMENT TECHNOLOGY: APPENDIX 5 TO WASTE MANAGEMENT AND CONTROL: A REPORT TO THE FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY. National Academy of Sciences-National Research Council, Washington, D. C., Committee on Pollution. Pub. 1400, p. 181-202, 1966.

The technology required to reach acceptable levels of water, land, and air pollution is considered. At the present time, improvement in water pollution control could be achieved by wider application of available technology. As better criteria are developed, and stricter standards set, there will be need for improved technology. Thus, research and development must be continued so that the improved technology for the future is available. Although the technology of burning many types of materials is well developed, both domestic and municiple incinerators need to be upgraded in efficiency. The effluent from municiple incinerators contains about 15 pounds of particulate and about five pounds of undesirable gas for each ton of waste burned. Disposal of solid wastes by sanitary landfilling represents an irretrivable loss of land areas and adversely affects the ecology of swamps and tidal lands. Since land pollution is closely related to both water pollution and air pollution, work on its abatement must avoid creating the other kinds of pollution. Primary sources of air pollution are automobiles and fossil-fueled power plants. Metropolitan areas are now approaching pollution levels that will not permit further expansion of power generation without effective control equipment. The cost of transporting power from distant plants may be less than the cost of installing and operating such equipment. Because of engine designing modifications, long-range abatement of air pollution from automobiles is in sight.

15946

Ketov, A. N., V. V. Pechkovskiy, V. V. Larikov, and A. S. Shligerskiy

DRY LIME METHOD OF REMOVING SULFUR DIOXIDE FROM POWER PLANT FLUE GAS. II. INDUSTRIAL TESTS. (Cukhoy izvestkovyy sposob ochistki topochnykh gazov tets ot sernistogo angidrida. Proizvodstvennyye ispytaniya). Text in Russian. Izv. Vysshikh. Uchebn. Zavendenii. Energ. (Minsk), no. 2:84-89, 1969. 3 refs.

A gas purifying arrangement patented by the authors has been tested under industrial conditions. The degree of SO2 removal was found to increase with lime consumption rate, and reached 60-78% with lime in amounts of 120-140% of stoichiometric values. When lime powder is introduced into the boiler fire box, the dew point drops from 348 to 333 K depending upon the amount of chemosorbent. Greatest purification was achieved with frontal jets (inclined to 25 degrees) and with a combination of frontal (inclined to 15 degrees) and lateral (at 0 degree) jets. The introduction of lime into the fire box has no noticeable effect on its operating characteristics or on the heating surface.

15962

Doumani, Thomas F.

PROCESS FOR THE SEPARATION OF SULPHUR DIOXIDE FROM GASES. (Union Oil Co. of California, Los Angeles) U. S. Pat. 2,370,020. 4p., Feb. 20, 1945. (Appl. Aug. 16, 1941, 3 claims).

A method is described for recovering sulfur dioxide from sulfur- containing gases produced by the catalytic treatment of petroleum fractions, the burning of sulfite ores in smelting operations, the burning of high sulfur coals, etc. The method comprises contacting the gas with an aqueous solution of nitrogen base and heating the resulting mixture to liberate the sulfur dioxide. The nitrogen bases, which are obtained from petroleum, coal tar, bone oil, or their mixtures without previous purification or, are mixed with water and the mixture is conducted to an absorption tower. When dissociated from sulfurous acid by heating, the bases separate as an oil less dense than the aqueous layer. These dissociated bases are used in subsequent cyclic and regeneration processes. Depending on gas and liquid flow rates, the process reduces gases containing 5-10% sulfur dioxide to less than one-tenth sulfur dioxide.

15976

Horvath, Tibor, Karoly Nagy, and Ferdinand Zoltan

PROCESS TO EXTRACT SULFUR DIOXIDE FROM FLUE GASES WITH SIMULTANEOUS PRODUCTION OF MAGNESIA REFRACTORY FROM MINERALS. (Eljaras fustgasok kendioxid tartalmanak kinyeresere, magnezit tuzallo anyagnak kozetekbol valo egyideju cloallitasa mellett). Text in Hungarian. (Assignee not given.) Hungarian Pat. 152,841. 4p., Dec. 12, 1965. (Appl. May 2, 1965, 7 claims).

The 0.2-0.5% sulfur dioxide-containing flue gases from power plants are first cooled to ambient temperatures and dust particles removed. The gases are then passed to a suitable gas absorption apparatus and washed with a watery suspension of a finely ground, preheated magnesium compound such as dolomite or serpentine. The sulfur dioxide and magnesium will combine to form mainly bisulfite; the solution will have a magnesium content of 14-19 g/l. If the suspension pH is kept above 4.75, the purity of the magnesium oxide will be 95-97%. The other condition of magnesium oxide selectivity is the inhibition of the oxidation of the sulfides of the other metals, e.g., calcium, small amounts of inhibitors, e.g., p-amino-phenol will suffice. The output of the gas absorption apparatus (or reactor column) is filtered or centrifuged, and the pure magnesium bisulfide solution heated to 80-100 C. The pH of the solution is raised to 9 or more by the addition of magnesium oxide or hydroxide, one or two hrs of stirring the hot solution will precipitate more than 80% of the magnesium salts in forms that can be easily filtered from the basic solution. The filtered salts can be roasted in conventional apparatus at 700-900 C. The gases are fed to sulfuric acid producing towers; the magnesium oxide is burned at 1500-1800 C into sintered magnesite. The sulfur dioxide removal from the flue gases is 70-90% efficient; of this quantity, 40-90% is converted to sulfuric acid. The conversion of the magnesium containing minerals is 50-90% effective; the magnesite-sinter is 95-97% pure.

16068

Schlachter, D. J.

REDUCTION OF STACK EMISSION THROUGH MODERNIZATION OF POWER PLANT FACILITIES. Preprint, Andrew Jergens Co., Cincinnati, Ohio, 13p., 1963.

A company's power plant operations were modernized to meet new emission standards by replacing a pulverized fired boiler with a boiler fired by a spreader stoker with a continuous moving grate. To achieve smokeless combustion, the boiler was equipped with pneumatic combustion controls, a tubular dust collector with section damper for low load operation, a convertible grate damper providing acceptable burning rates at both high and low loads, and overfire air jets and sidewall air jets for the proper mixing of fuel and air. Coal is mechanically distributed over the surface of the stoker grate by feeders equipped with rotor blades. The boiler satisfactorily meets steam load requirements of 50,000 lbs of steam/hr at maxium loads and 5000 lbs at minimum loads and simultaneously reduces stack emissions.

16173

PILOT PLANT ABSORBS SULFUR IN STATION STACK GASES. Elec. World, 168(15):29-30, Oct. 9, 1967.

A pilot unit for the chemical absorption of SO2 and SO3 was tested for several months in a power plant and was found to remove more than 90% of sulfur in stack gases and all the fly ash that remained after gases passed the precipitator. Flue gas is passed through a reactor which removes both SO3 and fly ash. From the reactor the flow goes to a receiving tank and then to a special treatment tank. Part of the solution, minus the SO2, SO3, and fly ash, is returned from the treatment tank to the reactor from which clean air is discharged to the stack. The remainder of the solution, which contains the SO2 removed from the stack gases, is pumped to a cooler and stripping column. SO2 vapor passes from the column to a compressor. The solution is pumped from the stripping column back to the receiving tank. The recovered SO2 is 99.9% pure and is marketed to sulfuric acid plants or converted to elemental sulfur. Estimated annual operating costs for the SO2 removal system are $2,008,600. Estimated sulfur recovery is 81,000 tons, the sale of which should cover investment and operating costs. Investment costs and operating costs are itemized.

16224

Van Duuren, H. and A. J. Elshout

THE CURRENT SITUATION IN THE ELECTRICITY-GENERATING INDUSTRY IN CONNECTION WITH THE CAMPAIGN AGAINST AIR POLLUTION. (De stand va zaken bij de elektriciteitsproduktiebedrijven in verband met de bestrijding van de luchtverontreiniging). Electro-Techniek (The Hague), 44(20):459-465, 1966. 3 refs. Translated from Dutch. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 24p., May 19, 1969.

Air pollution problems of power stations in the Netherlands were discussed. Control of air pollution is receiving full attention on the part of these industries. Data from stations in operation from 1954 to 1965 provide a description of the measures taken to avoid pollutant emissions, including flyash collectors and higher chimneys. Since the increasing demand for power is to a considerable extent covered by the delivery of electricity, the shift thereby developing from the fueling of small installations and small power plants to large power plants already signifies a positive contribution to combatting air pollution. It is also possible to make air pollution control a substantial part of the operating management by big investments in the field. Measurements of the short-term concentrations of SO2 around a number of power plants showed that these concentrations were lower than the maximum allowable concentrations. The long-term average concentration due to the stations was only a small part of the total ground-level concentration. In spite of the great increase in electricity productions and the resulting increase in fuel consumption, the increase in air pollution in the Netherlands is not disquieting as a result of the measures taken by the power plants.

16240

Wahnschaffe E.

CONTRIBUTION TO FORMATION OF SO3 AND SO2 IN FLUE GASES IN OIL FIRING SYSTEM. (Ein Beitrag zur Bildung von SO3 and SO2 in Rauchgasen einer Oelfeuerung). Text in German. Mitt. Ver. Grosskesselbesitzer, no. 108:166-73, June 1967. 11 refs.

The SO3 content in flue gases from an oil-fired steam generator were continuously measured using a sulfotherm, and the formation of SO3 and SO2 was studied. Flue gases with temperatures of 550 and 600 C were filtered and sent to the analyzer with temperatures above the dew point. The SO3 components were absorbed in condensating water vapor. The sulfuric acid which forms simultaneously with the sulfurous acid was thermally separated and cooled. Its electric conductivity which is proportional to the SO3 concentration in the gas was measured. The measurements showed that the SO3 formation is inversely proportional to the absolute temperature and directly proportional to the O2 content. Magnesium oxide proved to be best suitable for sulfur removal among the oxidation catalysts used as oil additives or blown directly into the firebox; however, it is uneconomical.

16248

Miller, D. M. and James Jonakin

KANSAS P & L TO TRAP SULFUR WITH FLUE-GAS SCRUBBER. Elec. World, 169(10):35-36, March 4, 1968.

An air pollution control system now being installed in a coal-fired power plant comprises a limestone injection and wet scrubbing system guaranteed to remove 83% of the sulfur dioxide and 99% of the particulates from flue gas. In addition, about 20% of the nitrogen oxides will be removed. Limestone, injected in a furnace at a rate of about 185 lb per ton of coal, will be calcined into a more reactive compound that combines with all the SO3 and a portion of the SO2 to form calcium compounds. The flue gas passes through an air preheater to the scrubber where the remaining SO2 and fly ash will be removed. Compounds resulting from reactions in the furnace and scrubber are precipitated out or dissolved, then sluiced with the fly ash to a settling pond. Field tests show that limestone and coal can be mixed without excessive segregation, that the mixture has little effect on pulverizer power requirements, and that the furnace will be less subject to slagging. It is concluded that the limestone scrubbing system is the most economical for meeting and surpassing future emission requirements. Initial cost of equipment and installation will be $3 million.

16250

Parker, William Clifford and Hubert Clarke

FULHAM BASE-LOAD POWER STATION: MECHANICAL AND ELECTRICAL CONSIDERATIONS. Inst. Civil Eng. J. (London), vol. 9:17-36, 1938 2 refs.

The design, construction, and operation of a large municipal coal-fired base-load power station are discussed in detail. Attention is focused on the gas washing plant for extracting sulfur dioxide from flue gases. The gas is washed with river water containing lime and other alkalies. In early experiments, the sulfur dioxide was neutralized by the lime and precipitated as a mixture of calcium sulfite and calcium sulfate, the latter crystallizing when formed at concentrations greater than saturation. Crystallization is now prevented by maintaining a suspension of gypsum crystals in the washing medium. When more than five percent of gypsum crystals is suspended in a liquor, which commences in a highly saturated state, the supersaturation falls to nothing within almost one minute. In practice, a delay period of three and one-half minutes is allowed between cycles of the recirculating liquid, so that the presence of the suspended crystals effectively prevents any supersaturation existing in the washing liquid from entering the packed scrubbers. Flue gases are generally as low as 0.0006 grain of sulfur per cu ft. Only traces of dust having a size less than five micron pass out with the exit gases to the atmosphere.

16279

Curran, George P., Carl E. Fink, and Everett Gorin

BENCH SCALE RESEARCH ON CSG PROCESS. OPERATION OF THE BENCH SCALE CONTINUOUS GASIFICATION UNIT. PHASE II. (INTERIM REPORT). Consolidation Coal Co., Library, Pa., Research Div., Office of Coal Research, Contract 14-01-0001-415, R and D Rept. 16, 233p., 1968. 11 refs. CFSTI: PB184720

The salient features of the carbon dioxide acceptor process were studied and the feasibility of the process determined in a pre-pilot continuous prototype unit. The unit was designed to study the operation of a two-vessel system with a simultaneous operation of one vessel as a regenerator and the other as either a hydrodevolatilizer or a gasifier. Sub-bituminous coals and lignite or lignite chars were used in the study. A number of dolomites and limestones and a synthetic 'melt' type of acceptor were also tested. The study demonstrates in particular the feasibility of handling a dual fluo-solids system with the acceptor continuously showering through and segregating at the bottom of a fluidized char under full process conditions of temperature and pressure. Both dolomites and limestones were found to maintain the equilibrium activity required to absorb carbon dioxide. Acceptor conglomeration was not a problem in the fluidized bed. However, serious operating problems were found with western sub-bituminous coals due to deposit formation in the regenerator and bulk ash fusion. Excessive particle swelling and some coking was experienced when these coals were processed directly in the devolatilizer. Light preoxidation of the coal at 500 F prevented coking. Coking was not a problem in the direct hydrodevolatilization of lignites, but particle swelling occurred and resulted in a low density char. Lignite preoxidation is suggested to increase the char particle density. Lignites are sufficiently reactive to permit operation of the gasifier at 1500 F and a total system pressure of 11 atm. With less reactive sub-bituminous chars, a gasification temperature 50 F higher is needed to achieve gasification rates comparable with those of lignite. To achieve adequate CO2 absorption, the system pressure must be 20 atm. A correlation of the experimental data is presented which can be used to predict equilibrium acceptor activity as a function of acceptor make-up rate and operation temperatures in the gasifier and regenerator. The sulfur cycle is discussed with respect to sulfur pick-up in the gasifier and devolatilizer, sulfur rejection in the regenerator, and reactions of fuel char sulfur in the regenerator.

16282

Bechtel Corp., San Francisco, Calif.

ALKALI SCRUBBING TEST FACILITY. PHASE I: PRELIMINARY ENGINEERING. NAPCA Contract PH 22-68-27, 332p., May 1969. 124 refs.

Comparative tests of various scrubbers was carried out to identify those meeting the requirements of limestone injection-wet scrubbing process for removing sulfur dioxide and particulates from waste gases emitted by coal-fired power plants and industrial complexes. The criteria used in selecting scrubbers were pressure drop, turndown capability, plugging characteristics, mist elimination, and scrubber liquid requirement. The data obtained for each scrubber are tabulated, as are estimated capital and operating costs. Less expensive design alternatives are considered. Also studied was the chemistry of SO2 absorption. In the limestone scrubbing process, which circulates a solution saturated with CaSO3, the shift from monosulfite is considered the key mechanism responsible for absorbing SO2 from flue gas. This means that the solution entering the top of the scrubber need not contain Ca(OH)2 if the required stoichiometric amount of CaSO3 is present. The pH of the liquor entering the absorber should be between 6-7. As the liquid passes through the absorber, it absorbs SO2, sulfite shifts to bisulfite, and the pH falls to between 5-6. In the liquor circuit outside the scrubber, solution occurs and Ca(OH)2 forms which then reacts with bisulfite to precipitate CaSO3. The circulation rate required for given SO2 concentrations is determined by the solubility of CaSO3. If the rate is too large, a slurry can be used. Final evaluation of scrubber performance in laboratory facilities will require more data on sufficient gas-liquid phase equilibrium for gas-phase SO2 concentrations.

16346

Uno, T., S. Fukui, M. Atsukawa, M. Higashi, H. Yamada, and K. Kamei

SO2 CONVERSION-6. SCALE-UP OF A SO2 CONTROL PROCESS. Chem. Eng. Progr., 66(1):61-65, Jan. 1970. Parts 1-5. Ibid, Aug. p. 62; Sept. p. 69; Oct. p. 74; Nov. p. 73; and Dec. p. 61, 1969.

At a semi-commercial power plant, which treats 150,000 cu Nm hr pf flue gas, up to 90% sulfur dioxide removal is effected by a process which uses activated manganese oxide as the absorbent. Ammonium sulfate is recovered as a by-product through regeneration of the spent absorbent. In the process, the powdery absorbent is fed to the absorber where it is dispersed in the flue gas, transported with the gas stream, and reacted with the sulfur oxides. The resultant manganese sulfate and the excess of unreacted absorbent are collected in a mechanical separator and electrostatic precipitator. The greater part of the collected absorbent is returned to the absorber as recycled solids and the remainder regenerated and recycled. Absorption takes place at 100-180 C while the absorbent is transported with the flue gas. A recycle-to-refreshed solids ratio of 6:1 or 7:1 is used, depending on the sulfur oxides concentration of the flue gas. The amount of absorbent escaping with flue gas is less than 10 mg/cu Nm and its manganese content, less than 15%. The high collection efficiency of the plant is due in large part to absorbent properties such as large particle size, high specific density, and optimum electric resistivity. The absorber scale-up is described in detail and equations given for over-all reaction rates. The scale-up shows that the effect of gas velocity and absorbent concentration are negligible in commercial absorbers, which can be designed on the basis of the calculated value of mean residence time at given conditions.

16418

Cortelyou, C. G.

COMMERCIAL PROCESSES FOR SO2 REMOVAL. Chem. Eng. Progr., 65(9): 69-77, Sept. 1969. 5 refs.

Projections of the amount of sulfur oxides emitted from major sources for ten year intervals from 1970 2000 are presented. Four stack gas sulfur removal processes are given economic and technical evaluation: dry dolomite injection with wet scrubbing, catalytic oxidation, the alkalized alumina process, and the Reinluft dry char absorption process. These methods will find their widest application among large combustion units, such as power generating stations; in general, they will not be applied to existing facilities. Cost considerations indicate that the processes will utilize the highest sulfur content fuel available. The eventual choice of processes will be guided by stage of technical development, storage, transport, and marketing costs associated with each type of by-product. (Author summary modified)

16425

Slack, A. V.

REMOVAL OF SULFUR OXIDES FROM POWER PLANT STACK GASES: OUTLINE OF MAJOR PROBLEMS. Preprint, Metropolitan Engineers Council on Air Resources, New York, N. Y., p. 42-49, Oct. 1967. 2 refs. (Presented at Symposium Metropolitan Engineers Council on Air Resources, 0New York City, Oct. 1967.)

Various problems of sulfur oxides removal and its impact on process possibilities were reviewed. The discussion was restricted to twelve major removal processes which are being studied in large test units taking gas from a power plant or other sulfur dioxide producing plants: injection of pulverized limestone into boiler; scrubbing exit gas with lime slurry; absorption in alkalized alumina; absorption in manganese dioxide; absorption in metal oxides; absorption in calcium hydroxide; absorption in ammonia solution; continuous adsorption of cooled gas on carbon with intermittent washing; adsorption of gas on carbon in cyclic process with separate washing; adsorption of gas on carbon followed by heating; catalytic oxidation followed by condensation of acid; and catalytic oxidation followed by injection of ammonia. The several unresolved problems in reducing sulfur dioxide emissions from power plants make the status of both removal and recovery methods uncertain. Some of the problems do not have any obvious solution. These include the large tonnage of the product made, both in regard to space for discarding of waste products and the economics of marketing vary large quantities of saleable material produced; declining load factor and variable operation of power plants, with adverse effect on operation of a chemical recovery plant; and the growing use of nuclear power for new plants. For some processes, new fossil fuel plants are more amenable to fitting with sulfur dioxide recovery equipment than are the old ones. The main problem with limestone injection is the short retention time in the boiler and also the presence of cooled surfaces in the boiler, on which molten droplets of slag solidify. One of the main difficulties with lime slurry scrubbing is that the gas is cooled and therefore loses bouyancy which is important in getting pollutants high in the air before they drift earthward. Other problems in the process operation are the presence of undesirable gas constituents in stack gas, corrosion, gas pressure drop, and low product grade in recovery processes. The process operation problems are less difficult in some respects and progress is being made in solving them.

16496

Denes, S., L. Farkas, and Gy. Varju

HOT-LINE INSULATOR WASHING AS AN EFFECTIVE MEANS OF COMBATTING HEAVY POLLUTION. Preprint, 6p., 3 refs. (Presented at the Conference Internationale des Grands Reseaux Electriques, 22nd, Paris, June 10-20, 1968.)

In the area of thermal power stations fired by a high ash-content, low-grade coal, the pollution of insulators can cause flashovers that jeopardize the continuous operation of outdoor switching stations. At a Hungarian power station, this problem was minimized by the development of a mobile insulator washing unit provided with a water nozzle delivering a single continuous water jet. The components of the unit are assembled on a rubber-tire carriage easily moved by two operators. Protection against electric shock is provided by an automatically controlled valve for shutting off the water supply to the nozzle. All 120 kV insulators of the substation are washed in three and one-half hours without interference to the normal service of the high voltage equipment. Neither the conductivity of the river water used for washing nor the amount of suspended matter contained in the water have influenced washing operations. Moreover, satisfactory results have been obtained under extreme weather conditions. A comparison with silicone-grease treatments and stationary washing units shows that the method is more reliable and less expensive.

16500

Mactaggart, E. F.

SULPHUR RECOVERY FROM STACK GASES. A REVIEW OF CURRENT PRACTICE. Ind. Chemist, 16(190):323-324, 328, Nov. 1940.

Processes for removing sulfur from power station combustion gases and from smelter gases are summarized. When by-product recovery is not desired, sulfur can be economically removed from power plant stack gases by washing the gases with water. At one power station, 80-90% sulfur removal was obtained by preliminary washing with water followed by the passage of the gases through a suspension of chalk in water. In the case of smelter gases, reduction to sulfur is of interest when the concentration of sulfur dioxide in the metallurgical stacks does not exceed two percent. As a general rule, it is first necessary to concentrate the sulfur dioxide by a process such as the Ciba, or Sulphidine, process, wherein the sulfur dioxide is absorbed by a xylidine water mixture, which forms a homogeneous liquid when the concentration of sulfur dioxide is more than 100 g/l. On heating to 80-100 C, sulfur dioxide is evolved. Any sulfate formed remains in aqueous liquid from which it is removed by sodium carbonate. The xylidine, free of sulfur dioxide, is cooled and returned to the system.

16502

Cooper, D. R.

LOW EXCESS AIR FIRING LOWERS HEAT RATE AT LARGE UTILITY. Combustion, vol. 36:28-34, Aug. 1964.

By firing two boilers (each rated at 1,200,000 lb/hr steam flow at 1850 psig, 100 F superheat, and 100 F reheat) on 2-2 1/2% excess air with oil fuel, a steam plant obtained an average reduction in net heat of 60 Btu/kwh, with a yearly saving in fuel of $19,350. Nitrogen oxides were reduced from 621 ppm on normal excess O2 to 452 ppm on low excess O2, a reduction of 27%. The amount of fly ash collected on low air excess firing is relatively small, amounting to about 0.15% by weight of the fuel fired. Under excess firing conditions, as much as 300 lb of ash per day per unit were collected. There is also an unmeasurable but evident reduction in sulfur trioxide as the result of low excess air firing.

16510

Padovani, C.

SULFUR DIOXIDE EMISSIONS FROM LARGE HEATING PLANTS: PROBLEMS AND SOLUTIONS. PART II. (Emissione di ossido di zolfo delle grandi centrali termiche: problemi e soluzioni. Parte II). Text in Italian. Riv. Combust., 22(7/8):389-396, July-Aug. 1969. 65 refs. Part I. Ibid, no. 5, 1968.

The following fuel oil desulfurizing plants are under construction or in the planning stage: H-oil unit of 24,000 barrels/day at Shinoiba, Kuwait; an Isomax plant, 35,000 b/d at Mina Abdullah, Kuwait; and an Isomax plant, 40,000 b/d in Chiba, Japan. The economic problem of providing low-sulfur fuel oil in Europe differs from that of the United States in that there is a greater demand for gasoline and medium-to-light distillates and a higher demand for heating oils, a condition to be eventually offset by increasing demands for light petroleum products in petrochemistry, increased use of motor vehicles, and greater availability of natural gas. Future projects call for preliminary gasification under pressure, which can lead to the formation of hydrogen sulfide gas. Hydrogen sulfide liberated from the gasified fuel is more easily captured than SO2 in the exhaust gases, and lends itself more readily to the manufacture of elemental sulfur to be sold as a by-product. Gasification provides a fuel gas that can be highly varied in composition, with almost no additional expenditure of power. By making use of the chemical and physical enthalpies of these gases, the yield of the modern heating plant can be raised by 5-15%, plus compensations from the sale of by-products.

16548

Atsukawa, Masumi

REMOVAL OF SO2 FROM FLUE GAS OF THERMAL POWER STATION. (Karyoku hatsudensho haien chu no aryusan gasu no jyokyo ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 1(4):219- 224, Oct. 15, 1965.

The flue gas of a thermal power station contains 0.12 to 0.16% sulfur dioxide, an amount far lower than the allowable limit stipulated in the Smog Control Law. However, the emissions are a serious nuisance. The four important countermeasures are the use of low sulfur-content fuel, limiting the scale of power stations, diffusion of smog by tall chimneys, and desulfurization of flue gas. The first three do not give satisfactory results. The desulfurization of flue gas is more difficult by the thin concentration and large quantity of gas, low price of by-products, and so on. The desulfurization method is divided into wet and dry methods. Drawbacks of the wet method are the large quantity of water contained in the tail gas and its low temperature. The wet methods are subdivided into ammonium sulfate, gypsum, red mud method, etc. The desulfurization rate of ammonium sulfate method is 97% for flue gas containing 0.1 to 0.2% sulfur dioxide. The gypsum method can treat 62,500 N cubic meters gas containing 3% sulfur dioxide in a day. A new catalyst for use in dry desulfurization processes is activated manganese oxide. As determined by pilot plant studies, the desulfurization rate of this method is 90% for flue gas containing 0.1% sulfur dioxide. The dust collection rate is 99% using a mechanical and electrical dust collector. Tail gas temperature is maintained above 100 C.

16681

Willet, Howard P.

PROFIT ORIENTED SYSTEMS FOR POLLUTION CONTROL. American Institute of Chemical Engineers, New York, N. Y., American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., American Society of Civil Engineers, New York, American Society of Heating, Refrigerating and Air Conditioning Engineers, New York, American Society of Mechanical Engineers, New York, and American Society for Testing and Materials, Philadelphia, Pa., Proc. MECAR Symp., Design and Operation for Air Pollution Control, New York, N. Y., 1968. p. 75-85. (Oct. 24).

The development of pollution control systems that provide an economically profitable return on control costs is described; it is believed that such processes will enhance control activities by establishing an economic incentive to add to the public pressures on polluters to install control equipment. Profit oriented control systems are described for blast furnaces and the basic oxygen processes in steel fabrication, for foundry cupolas, kraft pulping, and for sulfur dioxide recovery from power and sulfuric acid plants. Venturi scrubbers, used to clean blast furnace gases, make it possible to obtain higher hot blast temperatures for preheating air blown into the furnaces and thus improve the economics of their operation. Gas takeoffs installed below the charging door on foundry cupolas reduce the size of the gas cleaning equipment required and permit the gas to be used as fuel for preheating air blasts to the cupolas. A new method recently introduced from Japan, called the OG Process, has a great profit potential in its application to the basic oxygen process in steel-making, primarily by collecting carbon monoxide without combustion. A series of pollution control techniques can be applied to the kraft pulping process to reduce capital and operating costs. An absorption system to eliminate SO2 pollution from sulfuric acid plants and to increase plant profits is nearing completion, and a concept called the Central Processing Approach is described, involving the establishment of central processing plants, to permit the profitable recovery of elemental sulfur from the sulfur oxide emissions of both large and small power producers.

16720

Stairmand, C. J.

REPORT ON THE REMOVAL OF GRIT, DUST, AND FUME FROM EFFLUENT GASES. Chem. Engr. (London), 221:CE257-261, Sept. 1968. 17 refs.

In general the difficulty of arresting particles increases with their fineness: Grit is relatively easy to collect in simple inertial devices while sub-micron fume requires highly sophisticated equipment such as electroprecipitators, bag filters, and high energy wet washers. The performance data and U.K. costs of twenty types of dust collectors are summarized. Statutory or presumptive limits of emissions for a number of process operations in the U.K., Germany, and Switzerland are tabulated. This is a brief discussion of reports made to the Working Party on Air Pollution of the European Federation of Chemical Engineering.

16731

Quig, Robert H.

NEW CONCEPT FOR CENTRAL RECOVERY OF SULFUR FROM INDUSTRIAL STACK GASES. Chemico World, 4(3):6-9, April 1969. 6 refs.

The electric utility, fossil fuel, chemical and other heavy industries are faced with an increasing problem in the control of sulfur dioxide emissions from their stacks. This article describes current methods of SO2 control and introduces an outlook for a new and commercially effective SO2 recovery system via the central process plant. Since most sulfur recovery systems appear to require large installations with high load factors to demonstrate economic returns, the smaller industrial plant is not in a position to recover stack gas. A venturi scrubbing system that could be installed on an existing steam plant would scrub SO2 and fly ash from stack gas using dolomite or lime as scrubbing agents. Using higher grade alkali materials such as sodium carbonate or magnesium oxide, this same scrubber could be used in the sulfur recovery system via the central process plant. Use of the central processing system will remove sulfur recovery activity with its concomitant capitalization and operating costs from the industrial and utility companies.

16746

Halzel, George C.

FLYASH DISPOSAL. Power Eng., 73(6):44-46, June 1969.

Disposal of fly ash from large power plant boilers is becoming a serious problem for plant designers and municipalities. Surface disposal in ash ponds and ash piles sometimes are sources of dust and air pollution which is objectionable. Commercial uses for fly ash have been explored but only a small portion of the fly ash produced can be consumed in this way. The Duquesne Light Company at its Colfax Station is now disposing of fly ash by sluicing it from the station into an abandoned section of a coal mine. The disposal system and the mine dewatering system are described. When the new Cheswick Station is put into operation the disposal problem will be increased substantially. The company estimates that at that time it will realize a $700/day saving over conventional disposal costs.

16815

Williams, David H., Jr., and John T. Dowd

DESIGN AND CONSTRUCTION FEATURES OF THE 1600 MW MITCHELL PLANT. Combustion, 41(2):19-23, August 1969.

Air and water pollution control were important considerations in the design of the 1600 MW Mitchell Plant of the American Electric Power Co. system. Thermal discharge problems were avoided by the use of cooling towers designed for a circulating water flow of 248,000 gpm with a 16 degree approach temperature and a 28 F range. The selection of the stack height was deeply studied. The stack for two 800 MW units would have to provide for the discharge and satisfactory diffusion of approximately 15,000,000 lb/hr of hot flue gas. At the discharge temperature of 300 F this represents about 4,700,000 cu ft/min. The basis for selection of a stack with a height of 1200 ft is discussed. Construction, scheduling, and control of the total plant is described.

16851

Cortelyou, C. G.

COMMERCIAL PROCESSES FOR SO2 REMOVAL. Chem. Eng. Progr., 65(9): 69-77, Sept. 1969. 5 refs.

Several stack gas sulfur removal processes have a potential for the economic, efficient removal of sulfur compounds before they enter the atmosphere. These processes are the subject of a study made by GCA Corporation of Bedford, Mass. for the American Petroleum Institute. More than 20 processes are classified as first generation, near first generation, and second generation processes based on the stage of their development both technical and economic. The four first generation processes which are examined more closely in this study include: Combustion Engineering's Dry Dolomite Injection with Wet Scrubbing, Monsanto's Catalytic Oxidation Process, U. S. Bureau of Mines Alkalized Alumina Process, and the Reinluft Dry Char Absorption Process. Flow diagrams are included for each of these processes. An 800 megawatt power plant was considered as a basic unit for comparison of the processes. It was assumed that such a unit with a 60% load factor would require 6 mill bbl/yr of heavy fuel oil containing 3% S, a stack gas temperature of 250 F, and power, water, and labor costs felt to be representative of U. S. industry. The Dolomite Injection Process has both the lowest capital costs and the lowest operating costs. In addition to comparing the economics of each process, the effect of changing variables in the assumptions is also examined. Since all of these processes are in a transitory state of development results of demonstration projects will help to evaluate the processes.

16862

Stites, J. G., Jr., W. R. Horlacher, Jr., J. L. Bachofer, Jr., and J. S. Bartman

REMOVING SO2 FROM FLUE GAS. Chem. Eng. Progr., 65(10):74-79, Oct. 1969.

Several years ago the catalytic oxidation system for SO2 removal from flue gases was demonstrated to be technically feasible in a small pilot plant which processed 400 scf/min of flue gas. A prototype plant designed to treat 24,000 scf/min has been built and operated to provide the process information required for commercialization. In the first step of the process hot flue gas is taken directly from the boiler at 950 F, and passed through a highly efficient, high temperature electrostatic precipitator designed to remove in excess of 99.5% of the particulates from the gas stream. The gas is then passed through a converter where the sulfur dioxide is catalytically oxidized to sulfur trioxide. The gas is cooled to 650 F in a tubular heat exchanger (boiler economizer) to recover heat, then further cooled in a Ljungstrom regenerative air preheater to about 450 F (above the dew point of sulfuric acid). The gas then passes through an absorption tower that used sulfuric acid as coolant to further reduce the temperature to about 225 F and condense the acid. A Brink Mist Eliminator removes the sulfuric acid mist from the gas which is ejected via the induced draft fan to the stack. The prototype plant has a demonstrated capability of removing all of the fly ash, 90% of the sulfur dioxide, and over 99.5% of the sulfuric acid produced. Although varying with stack temperature, an acid concentration of 80% is considered average.

16863

Wein, W.

OPERATING EXPERIENCE WITH POWER PLANT STACKS AND THEIR DESIGN. Combustion, 41(4):29-34, Oct. 1969.

The requirement for cleaner air has led to the construction of very high power plant stacks in recent years. Some types of design that have been used in stack construction in Germany are discussed. Sources of damage especially in older stacks include: excessive thermal stresses, too short a drying or heat up time, and corrosion due to temperatures below the dew point. Some of the characteristic damages resulting from these conditions and remedies that can be applied are outlined.

16872

Zentgraf, K. M.

THE PRESENT STATE OF FLUE GAS DESULPHURIZATION. Combustion, 41(5): 6-11, Nov. 1969.

A very large number of methods for the desulphurization of flue gas from power plants are known and new concepts are being continuously developed. Only a few of these methods, however, have extended beyond the theoretical proposal or a laboratory test. Methods are discussed here which have progressed further than most concepts and which are being tested in prototype units or actual power plants. Furthermore, the operating costs of these methods are discussed as well as flue gas problems related to the wet scrubbing method. Of the ten methods tabulated, six methods, which also yield a marketable product have specific investment costs of between 43 and 85 DM/KW hr. To maintain the operating costs of such plants within bearable limits, the degree of desulfurization as well as the sulfur content of the fuel must be high. This way the fixed cost portion can be reduced and income from the end product--if easily marketable--could be high. If high sulfur containing fuel could be obtained at a discount-- as practices already in the USA--these savings would also benefit the desulfurization process. The rest of the methods given in Table 2, whose costs are below 17 DM/KW hr, are suited especially for low plant load factors.

16968

Johnstone, Henry F.

RECOVERY OF SULFUR DIOXIDE CONTAINED IN WASTE GASES. (Texas Gulf Sulphur Co., New York) U. S. Pat. 2,676,090. 18p., April 20, 1954. 4 refs. (Appl. Jan. 26, 1953, 15 claims).

A process was invented for the recovery of sulfur dioxide from waste gases resulting from combustion of sulfur-containing coal or the roasting or sintering of sulfur-containing materials. The waste gas is reacted with an aqueous ammonia solution in two or more zones. The gases are sequentially passed from the first zone to the second zone where the gases are absorbed by the ammonia solutions. A solution of ammonium sulfite is formed and divided into two portions. Sulfuric acid is added to the effluent solution and ammonium sulfate and sulfur dioxide is formed. Sulfur dioxide is separated from the solution leaving a residual solution of ammonium sulfate which is crystallized and recovered. Sulfur dioxide mixed with water vapor is stripped from the second portion of ammonium sulfite solution by heating. The water vapor is condensed and the separated sulfur dioxide is collected. The condensate, composed predominately of ammonia, is recycled to the second zone. The residual ammonia solution is recycled into contact with the waste gases in the first zone.

17004

Klimecek, Rostislav, Jaroslav Skrivanek, and Jan Bettelheim

STUDY ON DESULFURIZATION OF WASTE GASES. (Beitrag zur Entschwefelung von Rauchgasen). Text in German. Staub, Reinhaltung Luft, 26(6):235-238, June 1966. 7 refs.

To satisfy the future power requirements of Czechoslovakian industry in the coming decade, extensive use of lignite is necessary. Lignite contains 2% sulfur and waste gases contain 0.15 to 0.30% sulfur dioxide. The SO2 emission of a single steam power plant with a power output of 1000 MW is 100,000 tons/yr. The existing plan to build the required number of power plants of this capacity in the North Bohemian lignite region raises a very serious air pollution problem. The Research Institute for Inorganic Chemistry, evaluated the existing methods of SO2-removal from industrial waste gases with regard to their effectiveness and economic aspects. The most suitable SO2 removal method is one where SO2 is absorbed by aqueous solutions of ammonia or of ammonium bisulfite and which offer the possibility of producing saleable by products. So called 'noncyclic' and 'cyclic' variants of these methods have been developed. A new design of the absorber tower for implementation of these methods incorporates 26 mm diameter helices wound of 3 mm diameter aluminum wires with a pitch of either 12 or 20 windings per 10 cm of height, which perform the same function as Raschig rings but are superior to them. The optimal helix dimensions were found by systematic empirical tests the results of three series of which are shown in three graphs.

17124

SO2. IS IT A HEALTH HAZARD UNDER NORMAL CONDITIONS? WHAT ARE THE PRACTICAL APPROACHES TO CONTROL? Coal Age, 73(4):72-81, April 1968

Ground-level concentrations of sulfur oxides rarely are of a magnitude constituting a health hazard. Power and industrial plants do not add to existing levels when equipped with tall stacks to insure upper-air dispersion and dilution. Other control approaches include removal of the oxides from stack discharges and solvation and conversion of coal. The Dept. of Health, Education, and Welfare recommends that the SO2 in the atmosphere in populated areas not exceed an average of 0.1 part per million parts of air more than 1% of the time over a 24-hr period. There is a growing tendency throughout the country to require very low sulfur contents in coal and fuel oil or to forbid their use completely in favor of some other source of heat; nuclear is preferred, with natural gas as another choice. Various comments are made by various notables that no ill effect had ever been recorded for less than 2 ppm, some 20 times the proposed HEW criterion. It is claimed that because SO2 is one of the most easily measured of the foreign substances in air, it is frequently used to describe air pollution; British experience has shown that other substances are far more harmful.

17250

Kato, Kazuo

STACK SMOKE CONTROL IN A LARGE-CAPACITY BOILER FURNACE. (Daiyoryo boira no baien boshi ni tsuite). Text in Japanese. Nenryo Oyobi Nensyo (Fuel and Combustion), 36(8):753-763, Aug. 1, 1969.

Some practical methods to reduce smoke dust from oil burning in a large-capacity boiler furnace at a thermal power plant were discussed. Apparently, the most attainable method was to control sulfur trioxide and acid smut generation by mixing some chemicals with heavy oil to promote burning and to denature generated sulfur dioxide by injection into the emission gas. A relationship exists between the amount of air supply and the generation of acid smut and SO3. An increased air supply is proportional to the increase of SO3 and decrease of acid smut. Therefore, the minimization of the air supply is serious in controlling acid smut generation. Factors influencing oil burning under a fixed amount of air for a large-capacity boiler are the distribution of a secondary air supply (open-width of second damper), the amount of circulating gas and the location of its inflow, the open width of a burner tilting and the pressure distinction between heavy oil pressure and aerosol vapor pressure. Other factors include heavy oil temperature and management of the burner chips. Additional procedures responding to these techniques indicate the necessity of a fixed dust collector, cleaning the chimney, adaptation of the sulfur dioxide removal instrument, and the promotion of stack smoke dispersion.

17318

Kriz, Milan, Josef Vejvoda, and Bedrich Kedron

EMISSIONS FROM GAS PLANTS, COKING PLANTS, AND THERMAL POWER STATIONS AND MODERN METHODS OF THEIR LIQUIDATION. (Exhalace z plynaren, koksoven, tepelnych elektraren a moderni zpusoby jejich likvidace). Text in Czech. Ustav Vyzkum Paliv Monograph, no. 6, 156p., 1969.

Air pollution in Czechoslovakia as caused by gas plants, coking plants, and thermal power stations is studied. Future developments in these areas up to 1980 are indicated and appropriate control methods are suggested. The number of Lurgi gas plants, which are the major sources of town gas, are not expected to increase, though existing plants will intensify their operations. The present volume of coke production will remain unchanged to 1980. Enormous development is expected in the power station industry, the capacities of which will be designed for a brown coal with a high sulfur content. The study discusses dust generation in the Lurgi process and the most modern control methods used abroad. Desulfurization of waste gases from Lurgi plants is considered with special references to the waste gases from a recently installed Rectisol plant. In considering measures to improve the quality of air around coking plants, considerable attention is give to gas purification, tar separation and treatment with ammonia, and coke-oven gas secondary cooling. A method for the desulfurization of coke-oven waste gas by vacuum-soda is reported. A major part of the study is devoted to the problem of removing SO2 from thermal power plants. Promising dry desulfurization processes proposed for other countries, and Czechoslovak studies on the limestone process, are described. Electrofilters and other dust collecting systems for thermal plant fly ash are reviewed. Also considered is the problem of separating arsenic from the waste gas of one power station. Finally, provisions of the Czechoslovak Clean Air Act of 1967 are criticized. (Author summary modified)

17338

Zielke, Clyde W., Howard E. Lebowitz, Robert T. Struck, and Everett Gorin

SULFUR REMOVAL DURING COMBUSTION OF SOLID FUELS IN A FLUIDIZED BED OF DOLOMITE. J. Air Pollution Control Assoc., 20(3):164-169, March 1970. 8 refs. (Presented at the American Chemical Society, Division of Fuel Chemistry, National Meeting, 158th, New York, Sept. 7-12, 1969.)

Sulfur removal during combustion of coal or low-temperature coal char using excess air in a fluidized bed of dolomite was demonstrated in a continuous bench scale unit. The sulfur dioxide produced during the combustion is fixed as calcium sulfate by reaction with calcium oxide in the dolomite as follows: CaO + SO2 + 0.5 O2 yields CaSO4. The ranges of conditions explored were calcium oxide-to-feed sulfur mol ratios in the range of 1 to 8, fluidizing velocities of 1.5 and 3.0 ft/sec, superficial gas residence times of 1 and 2 sec, and temperatures from 1700 to 1900 F, with 120% stoichiometric air at the operating pressure of 8 psig. The process was operable at all conditions studied using a highly caking Pittsburgh seam coal as well as two low-temperature chars. Desulfurization efficiency with a Ca-to-S mol ratio of 1 was 78%; at Ca-to-S ratios of 2 or higher desulfurization efficiency exceeded 90%. Continuous regeneration of the sulfated dolomite using partial combustion of carbon monoxide gas at 1950 F was also demonstrated. As high as 97% of the sulfur in the dolomite was liberated as SO2 by this treatment giving a gas that contained SO2 concentrations as high as 23 times that in the combustion gases. Dolomite life was investigated, with the dolomite subjected alternately to SO2 absorption during combustion and subsequent regeneration. It was demonstrated that by regeneration and re-use of the dolomite, the ultimate SO2 capacity can be extended in excess of four times that for a once-through process. Regeneration also permits recovery of elemental sulfur by processing the SO2-rich regenerator off-gas. (Author abstract modified)

17343

Hashimoto, Kiyotaka

THE POINT OF PLANNING AND ITS EFFECT ON OPERATION RESULT OF AN ELECTRIC PRECIPITATOR IN

VARIOUS INDUSTRY SMOKE ABATEMENT (II). TREATMENT FOR WASTE GAS OF A COMBUSTION FURNACE AT A THERMAL-POWER PLANT (I). (Gyoshubetsu ni miru denki shujin sochi no setsubi- keikaku to untenkoka (II) --- karyoku hatsudensho no nenshoki haigasu no syori (sono 1)). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 2(9):657-663, Oct. 15, 1966.

In Japan, coal-burning, heavy-oil-burning, or coal-oil-burning was adopted for industrial thermal-power generation. Fall-out, aerosols, and poisonous gases are considered in smoke pollution prevention. Powdered coal is used for coal-burning thermal power generation in great capacities and stoker-type furnaces are not used. This is one reason for so much smoke dust. The properties of smoke and the amount used in a powdered-coal-burning boiler are influenced considerably by various factors. The precipitation percentage must be maintained at 96-98%. Previously, the smoke of a thermal-power-generation boiler was not regarded as an object of smoke prevention, and precipitators were not operated. Now, the utility value of fly-ash is appreciated, and at almost all thermal-power plants, the precipitators for fly-ash production are being used. Fly-ash is chemically stable and is satisfactorily strong for use as concrete fillers. Various types of precipitators for fly-ash production were described. A multi-cyclone with a high precipitation efficiency or an electric precipitator are usually used as precipitators for smoke pollution prevention at thermal power plants. Other types cannot be used because of the high temperature and the large amount of waste gas. A multicyclone has little effect on precipitation of aerosols. As thermal-power generation grows to a larger scale, the development of a technique to make the precipitators smaller and more efficient is urgent.

17392

Shirasawa, Tadao

FUELS, COMBUSTION AND SMOKE ABATEMENT. (Nenryo, nensho to baien boshi). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 43(451):748-759, Nov. 20, 1964. 20 refs.

Smoke produced by the combustion of fuels is one of the most common causes of air pollution. The use of smokeless, ashless, and sulfurless fuels is most desirable. A smokeless coal developed by the National Coal Board of England is described. The process employes as a raw material a coal powder which is distilled for one hour between 375 and 450 C in a fluidized bed. The resulting powder is formed into the final product by either a Bronowski or Sharp process. A test apparatus to study the smoking tendency of coals is explained. Countermeasures for dust and sulfur are also described. Since the primary objective of combustion is efficient heating, fuel firing methods are examined. The nature of the fuel and the conditions of its mixing with oxygen are among the most important factors determining soot emission. The study of soot is very important because radiation from a luminous flame is emitted by incandescent carbon particles which exist in the flame under certain conditions of combustion. A wide variety of soot exists with respect to particle size and chemical compositon. Basic studies on the effects of pressure, temperature, type of hydrocarbon, and additives on the formation of soot from the flame are reviewed. Chemical processes leading to the formation of carbon in flames have not been fully understood. It is concluded that smoke abatement can be achieved by the application of those techniques of heat management which have been developed for the purpose of heat economy.

17531

Porteous, Andrew and Graham B. Wallis

A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY HUMID STACK GASES AT ALASKAN POWER STATIONS. Atmos. Environ., vol. 4:21-33, 1970. 10 refs.

The intermittent occurrence of ice fog formed by the freezing of clouds at super-cooled water at 20-40 C at U. S. Air Bases in Fairbanks, Alaska causes severe visibility problems. At these temperatures, water vapor nucleates and freezes on grit particles to form minute ice crystals that have no appreciable settling velocity. The principle source of water vapor emissions at the bases are power station stack gases. Dehumidification of the flue gases was experimentally studied in a countercurrent scrubbing apparatus to obtain optimum droplet size for both moisture and grit removal in a spray tower. In countercurrent scrubbing, sprays of cold water are directed into hot gas flows, with the water droplets in effect forming an efficient counter-current heat exchanger. Heat and mass transfer proceed simultaneously; the processes are rate controlled. Based on the experimental results, optimum droplet size for accomplishing both grid and moisture removal was determined to be about 1000 micrometer diameter. This permits initial flue gas velocities of 2.1 reciprocal msec which are low enough to eliminate the risk of particle entrainment.

17672

Coutaller, J. and C. Richard

IMPROVEMENT OF ELECTROSTATIC DUST-FILTERING BY SO3 INJECTION. (Amelioration du depoussierage electrostatique par injection de SO3). Pollut. Atmos (Paris), 1967:1-7, Jan.-March, 1967. 2 ref Translated from French. Franklin Inst. Research Labs, Philadelphia Pa., Science Info. Services, 17p. July 22, 1969.

Due to its cost and the nature of the product, the use of sulfuric anhydride in boilers to abate the emission of pollutants is limited. The essential properties of the injection product and the technical characteristics of the test installations are described as applied in a power plant. The undesirable phenomenon of 'return ionization' can be avoided by conditioning the dust so as to keep its resitivity below the critical level. SO3 is recognized as one of the most efficient conditioning agents. Testing procedures are described. It is concluded that in three short experiments at Creil and Blenod, the process of improving electrostatic filtering by SO3 injection has proven efficient. It provides in the first case, an important gain in the efficiency (4.5%) and is equivalent to a 3 rd field in service in the second case. To the investment cost one must add the product cost and the air-conditioning cost. These are the maintenance costs that can be evaluated only at the end of the second phase of a long-term experiment. It is unfeasible to rely on SO3 as an economic substitute as an element of a filter. It must remain a complementary mean. If the long-term experiment proves positive, then SO3 could be considered a precious but expensive remedy to the dust-filtering in electrostatic filters.

17685

Newell, J. E.

RECOVERY OF SULFUR FROM FLUE GASES BY THE SODIUM ALUMINATE PROCESS. (Die Rueckgewinnung von Schwefel aus Rauchgasen mit dem Natriumaluminat-Prozess). Text in German. Chem. Ing. Tech., 40(21-22):1111-1112, Nov. 1968. 1 ref.

One-third of the 3.2 Mio tons of sulfur dioxide emitted yearly into the atmosphere by the combustion of oil and coal in England is caused by the plants of the Central Electricity Generating Board (CEGB); in endeavoring to keep the SO2 concentration near the ground at a low level, the board has selected the sodium aluminate process. The CEGB is planning to use a fluidized bed reactor and to regenerate the contact catalyst with natural gas. The reactor intended for recovery of 120 tons of sulfur per day consists of a multi-tier arrangement of 21 cm deep fluidized beds of 1.6 mm diameter contact particles working in parallel. At a gas speed of 1 m/sec, a flue gas temperature of 310 to 330 C, and a working period of the contact in the reactor of about 2 hours, a 90% desulfurization of the flue gas is attained; the contact mass takes up about 5 weight % of S. The heating of the charged contact to 700 C, its regeneration by natural gas, and the cooling of the activated contact to the reactor temperature is effected on three stationary beds, to which true contact is successingly transported. The reduction of the sulfate to hydrogen sulfide during regeneration by natural gas proceeds almost as rapidly as when hydrogen is used. About 2.5 weight % of S is expected to be ultimately retained by the contact mass. The H2S originating during regeneration is reduced to elementary S in a Claus-process installation. In addition to marketable S, heat is recovered, since both the process of desulfurization of the flue gases and that of contact regeneration are exothermic.

17782

Barnhart, Donald H. and Erle K. Diehl

CONTROL OF NITROGEN OXIDES IN BOILER FLUE GASES BY TWO-STAGE COMBUSTION. J. Air Pollution Control Assoc., 10(5):397-405, Oct. 1960. 9 refs. (Presented at the Air Pollution Control Association 52nd Annual Meeting, Los Angeles, Calif., June 22-26, 1959.)

The results are reported of a program to control concentrations of nitrogen oxides, particularly nitric oxide, in flue gases from power plants burning residual fuel oil and natural gas. Preliminary development considerations and investigations are described; the latter were carred out using a water-cooled tunnel 12 ft in diameter and 22 ft long, designed to accomodate and test full-size burners. The introduction of a portion of the combustion air through the burners, and the remainder at some point beyond the burners, is the underlying principle of one method of reducing nitric oxide formation, termed 'Two-Stage Combustion.' This method, with auxiliary-air ports above the burners, was effective while still maintaining acceptable boiler performance; with minor changes to the burner, a total nitric oxide reduction of 56% was achieved when firing oil at full load. Similar results can be expected in gas firing. It appears that additional reductions would be possible if the air flow through the burners were reduced another 5 or 10%.

17905

McLaughlin, J. F. and J. Jonakin

SO2 TRAPPED IN FULL SCALE SYSTEM. Elec. World, 168(20):108-110, Nov. 13, 1967.

In order to determine the feasibility of removing sulfur dioxide and particulate matter from gases in a wet scrubber, a laboratory pilot plant was constructed and tested. A controlled amount of sulfur dioxide, additive, and fly ash was added to the stack gas of a natural-gas-fired boiler; the mixture was passed through a wet scrubber. The gas was sampled before and after the scrubber to determine the removal efficiency. The results are tabulated. Ninety-eight to 99% sulfur dioxide removal and 98 to 99.6% dust removal were obtained. The next phase of the investigation was conducted to determine whether or not the laboratory pilot data could be confirmed on a commercial size unit. In addition, furnace operating conditions during dolomite injection were studied. In the full-scale tests, dolomite was introduced to one furnace of a 325,000 KW, twin-furnace steam generator. Dolomite was injected in a sufficient quantity to react with all the sulfur dioxide produced when coals containing 2.8 to 3.8% sulfur were burned. The other furance was operated at the same firing rate and with the same fuel but without additive or scrubber. The results of the field tests are given. The data shows that sulfur dioxide removal can be maintained at a very high level (95% or better). Flow charts of the system are presented.

17979

Rudorff, D. W.

FULHAM WASHES FLUE GAS. Power, vol. 81:341-343, June 1937.

The flue-gas-washing plant of the 300,000-KW Fulham power plant in London (England), which will, when completed, consume 2200 tons/day of coal containing from 0.75 to 1.5% sulfur employs the Hondeu-ICI system of gas scrubbing which is capable of reducing the sulfur compounds in the flue gas to 0.02 grains/cu ft and its dust content to 0.08 grains/cu ft and its dust content to 0.08 grains/cu ft (at 1 atm and 32 F). In this scrubbing system, the intimate contact between flue gas and washing liquid is obtained by a combination of rain and surface-film action. Milk of lime is added to the washing water to achieve a substantially complete absorption and neutralization of sulfur dioxide and other acid constituents of the flue gas. This lime combines with carbon dioxide absorbed from the flue gas to produce (insoluble) chalk and (soluble) calcium bicarbonate. The latter is the active absorbing and neutralizing agent and fresh amounts of it are formed from the chalk as the absorption of SO2 and other acids proceeds. To keep up the supply of calcium bicarbonate and to prevent the recirculating liquor from becoming acid, fresh milk of lime is fed into the system at a rate proportional to the acid absorption. The pH valve of the washing liquor is maintained at 6.7 to 6.8 at the scrubber inlet and at 6.4 to 6.6 at the scrubber inlet and at 6.4 to 6.6 at the liquor exit from the scrubber. SO2 and SO3 contained in the flue gas are absorbed as calcium sulfite and calcium sulfate and the washing liquor becomes charged with these relatively insoluble compounds. When the degree of their supersaturation attains an empirically determined limit, their precipitation is allowed to take place in vertical delay pipes of large cross-section and considerable length. The sludge accumulating at the bottom is continually withdrawn and passed into a thickener plant from which the clarified liquor is returned to the scrubber; the thickened sludge is discharged into a barge.

18034

Remirez, Raul

CATALYTIC ROUTE IS READY FOR FLUE-GAS CLEANUP JOBS. Chem. Eng., 76(9):86-88, April 21, 1969.

The Cat-Ox process, which desulfurizes by the catalytical oxidation of SO2 to SO3 and the subsequent formation of H2SO4, is said to remove all of the fly ash and 90% of the SO2 contained in flue gas while recovering high strength sulfuric acid for sale. Tests conducted in a prototype unit have proved the feasibility of the process and have solved problems such as fly ash buildup in key pieces of equipment. A process flow sheet and some economic data are included.

18045

Stelle, William W.

TALLEST SMOKE STACK FOR MITCHELL PLANT. Civil Eng. (N.Y.), 39(3): 44-47, March 1969.

A 1600 Mw power plant in West Virginia features a stack 1200 ft. high, perhaps the world's tallest. Dictating the height were such considerations as ridges up to 650 ft. high, and acceptable levels of SO2 concentration at ground level downwind. The stack has a concrete shell (slipformed) and steel lining. Some details of the design features and the bases for design are given.

18063

Love, L. R. and S. F. Whirl

DUQUESNE LIGHT BURIES ITS FLY-ASH PROBLEM. Coal Age, 74(3):90-94, March 1969.

The troublesome air pollution problem of handling fly ash and the equally troublesome water pollution problem of disposing of acid mine water are being solved simultaneously by sluicing alkaline fly ash into an abandoned section of a deep mine and pumping neutral or slightly alkaline water to the river. The disposal system has operated continuously for 18 mo. at Duquesne Light Co.'s Colfax power station and Harwick mine. The system is described in detail, discharge water quality is discussed, and a limited appraisal of the economics of the system is made.

18110

Ludwig, John H.

AIR POLLUTION CONTROL TECHNOLOGY: RESEARCH AND DEVELOPMENT ON NEW AND IMPROVED SYSTEMS. Law and Contemporary Problems, 33(2): 217-226, Spring 1968. 11 refs.

In the area of control of pollution from stationary sources, major research and development is now concentrated on the control of sulfur oxides. In the future there will be expanded programs for other pollutants, especially nitrogen oxides. Major emphasis on control of emissions from motor vehicles is now focused on reduction of carbon monoxide and hydrocarbons. Future efforts will focus on control of nitrogen oxides and particulates and on unconventional vehicles with low pollution potential, such as electric-powered and steam-powered cars. Instruments and techniques are now available for measuring many pollutants, especially inorganic gases, but there is a need for automated, smaller-sized instruments both for stationary sampling stations and for airborne sampling of the atmosphere. There is also a need for remote-type monitors capable of measuring stack emissions from a distance. In the area of meteorology, a number of urban diffusion models and an air pollution potential forecast program are now operational; improved models and quantitative forecasting methods are under development.

18111

Ergun, Sabri and Ernest H. Bean

MAGNETIC SEPARATION OF PYRITE FROM COALS. Bureau of Mines, Pittsburgh, Pa., Rept. Invest. 7181. 25p, Sept. 1969. 30 refs.

Previous studies of magnetic separation of pyrite from coals have been reviewed critically. Magnetic susceptibilities of United States coals of differing rank have been measured. The effects of crushing, magnetic mixing, drying, weathering, and heat treatment on the enhancement of the magnetism of pyrite have been analyzed. The importance of size distribution of pyrite in the coal and the necessity of crushing to liberate the pyrite has been discussed. (Author's Abstract)

18142

LABORATORY TESTS AID AIR POLLUTION CONTROL. RECENT WORK IN AUSTRALIA. Heating and Ventilating Eng., 42(502):588, May 1969.

Future equipment to be installed at the new Liddell power plant, New South Wales, Australia, to prevent air pollution is described. Pulverized coal will be burned at a rate of 700 to 800 tons/hr, giving rise to 175 to 200 tons/hr of very fine fly ash. The coals from 14 seams were tested for their fly ash behavior, and the two major seams which behaved the least satisfactorily will be burned at Liddell. An electrostatic precipitator will remove 98.5% of the ash from the flue gases. Tests run on this station after its completion should aid in improving the efficiency of established power stations.

18143

Dennis, Carl

HOW MUCH WILL POLLUTION CONTROL COST YOU. Elec. Light Power, p. 84-85, June 1969.

Some of the alternatives and equipment available to industry to comply with air pollution control legislation were discussed in reference to overall control cost. To determine the economics of several 'front-running' SO2 removal or dispersal systems, EBASCO evaluated four different types for plants of about 800 mw capacity. Included were systems by Combustion Engineering, Foster Wheeler (Universal Oil Products), Chemico, and the tall-stack system. The fourth had the lowest capital cost and the lowest operating cost; this system, however, limited station capacity and sulfur content of fuel. Calculation of fuel costs was complicated by some utilities having a choice of either high or low sulfur coal. The single fuel plant could reduce sulfur content by more sophisticated preparations at the mine or remove sulfur during the pulverizing process.

18154

Diehl, Erle K.

SO2 REMOVAL -- STATE OF THE ART. Nat. Eng., 73(6):6-10, June 1969.

A general review of SO2 removal from combustion gases is presented. Sulfur in coal occurs in two main forms. The organic sulfur is bound as an integral part of the coal, and the pyritic or mineral sulfur, occurs in discrete particles in the coal mass. An appreciative amount of pyrite sulfur could be freed from the coal by utilizing a pulverizer. The coal is cycled inside the pulverizer, and the pyrite is separated by gravity. SO2 emission may also be controlled by its removal from the flue gases. One method is to combine limestone or dolomite with the flue gases. This method has a 20%-40% possible removal efficiency. Additives plus wet scrubbing is another method; the combined process was reported to be 95% effective. In the alkalized alumina process, flue gas contacts a highly-reactive solid absorbent which binds the SO2 as a sulfate. Rengeneration of the absorbent for recycle releases hydrogen sulfide which is converted to elemental sulfur. Catalytic oxidation is another method of SO2 removal, involving the oxidation of SO2 to SO3 in a higher temperature reactor. With this method, sulfuric acid is the recovery product.

18161

Ford, Eric

COTTAM POWER STATION PROVIDES NEW APPROACH TO ASH AND DUST HANDLING. Steam Heating Eng. (London), 38(451):6n10, June 1969.

The dust and ash handling arrangements at Cottam Power Station are discussed. The systems are designed to remove 3960 tons/day of dust and 960 tons/day of ash in a 400 minute period. Dust sources are the precipitators, the economizers, and the air heaters. Dusts are drawn by vacuum into the water-operated ejector-wetting unit, and then discharged to a sluiceway. An outdoor sump receives the discharge from the sluiceways, and two agitator nozzles keep the dust in solution. The wet dust is pumped to a lagoon 4000 ft away. The scheme for the removal of ash from furnace bottoms calls for the pumping of slurry from the ash sump up to a receiving tank hopper where it passes over screens to remove material 0.25 in. in diameter. This material is discharged direct to the ash compound for removal. Underflow from the screens gravitates to a recirculating sump where it is pumped by Vacseal pumps to hydrocyclones and then to dewatering tanks. The hydrocyclones or hydraulic cyclones discharge the solids in the form of a concentrated slurry into a dewatering tank. This consists of a chaintype dewatering conveyor which carries the 0.25 in. material up an incline to allow drainage and discharges it via a chute to the ash compound.

18167

Werner, R. P., and J. G. Singer

400-MW CYCLIN UNIT SLATED FOR JUNE, 1971. Elec. World, 170(8): 30-31, August 19, 1968.

A 400-Mw, heavy oil fired, cycling unit will be installed by Connecticut Light & Power Co. at its Montville station. The turbine unit features quick response, greater reliability, and low capital cost. Main steam conditions at the throttle will be 1800 psig and 950 F with a single reheat to 90 F. The unit will be designed to meet proposed state and federal criteria for air quality. The oil-fired boiler will emit negligible particulate and require no fly-ash handling. As in other NU generating stations, injection of a magnesium-oxide fuel-oil additive will eliminate acid smuts and reduce sulfur trioxide. Intention is to operate the boiler at 3% excess air to further reduce sulfur trioxide. The boiler's tangential firing affords the opportunity to achieve low-excess air operation at least cost and with fewest operating problems. The gas leaving the boiler will be 600 F. This combined with a stack discharging at 409 ft elevation would produce the same plume rise as that from a 1000 ft stack with the usual exit-gas temperature. This plume rise will promote dispersion of stack gases, even during temperature inversions and smog-producing conditions. The design does not preclude the later installation of SO2 scrubbing equipment.

18290

Thomas, S.

'CLEAN AIR, COAL AND THE ENGINEER'. Certificated Engr., 42(4): 91-116, April 1969.

A comprehensive picture of coal combustion as it affects atmospheric pollution and its relationship to the Atmospheric Pollution Prevention Act is presented. Coal burning boilers often violate the Act, which states that smoke emissions shall be no darker than No. 2 of the Ringelmann Chart. The various methods of firing solid fuels and the several types of combustion fuel beds used are described. Also presented is a detailed discussion of the industrial fluidized bed boiler. This method eliminates CO from the exit gases and eliminates fly ash-fouling. The addition of small amounts of dolomite retains all sulfur compounds. Control equipment used in the retention of SO2 from stack gases is reviewed.

18296

Larsson, Olov

DIMENSIONING OF FLUES AND RUNNING CONDITIONS IN MEDIUM-SIZED HEATING PLANTS. (Rokkanalers dimensionering och driftforhallande i medelstora panncentraler.) Text in Swedish. National Swedish Building Research (Statens Byggforskningsinstitut, Stockholm, Sweden), 1969. 5 refs.

The National Swedish Institute for Building Research has conducted a field study of both old and new heating plants in the southern and central parts of Sweden with maximum effects varying from 200 to 8200 Mcal/h. All plants were fired with oil fuel, classes 3 or 4 (some with class 4 which contains little sulphur). The overwhelming majority of the plants were equipped with welded boilers, while 75% of the oil burners are of the pressure jet or emulsion burner types, 18% low air pressure, and the rest had rotary burners. Approximately 50% of the heating plants studied have natural ventilation units and about 30% of those heating plants studied have natural ventilation units and about 30% of those plants with mechanical ventilation (flue gas fan) have separate flues leading from each boiler to the mouth of the chimney. The concentration of solid matter in the flues was measured for different boiler loads and the amount of matter per kg of fuel oil was calculated. Temperatures of flue gases, amounts of soot, velocity of flue gases, static pressure, excess air, and temperature of internal walls were also measured. The mean for the concentration of solid matter at all tests averaged about 74 mg/cu m. Flue gases, while the corresponding mean for the amount of solid matter present was 1.7 g/kg fuel oil. The usual estimate for the CO2 content in the flue gases is 12-14%, at which level 74 mg/cu m would correspond to 1.0 g/kg of fuel oil. The survey showed, however, that such high CO2 contents rarely occur at the point where the content of solid matter is measured. The mean for the CO2 content in the plants studied was 7.5%. Only a small number of the plants tested had chimneys whose heights with regard to the amount of flue gases emitted and to the sulphur content in the oil were in accordance with the advice and instructions published by the authorities. Measurements of soot quantities according to Bacharach show that only about 35% of the boilers have Bacharach number 3 or less. Measurements showed that about 80% of the plants had, under normal running conditions, flue gas temperatures lower than 145 C at the mouth of the chimney. About 30% of the plants had flue gas temperatures lower than 100 C. The report also describes the velocity of flue gases, total amount of air leakage and damages caused by corrosion.

19029

Catchpole, S.

THE CONTROL OF POWER STATION CHIMNEY EMISSIONS. Preprint, Inst. Mech. Engrs. London, 13p., 1968. 11 refs. (Presented at the Symposium of the Institution of Mechanical Engineers, Atmospheric Pollution by Industrial Processes and a Review of Treatment Methods, Oct. 17-18, 1968), Paper No. 5.

The methods which were developed for controlling emissions from electrical power stations are discussed; pollutants associated with flue gas from the combustion of fossil fuels are sulfur dioxide, grit, dust and smoke. Sulfur dioxide may be controlled by an adequately high dispersion level; grit and dust by arrestment at their source; and smoke may virtually be eliminated by proper combustion techniques. A plume emitted high in the atmosphere in a low-level temperature inversion remains aloft and contributes nothing to ambient concentrations at ground levels. The design of a tall chimney for pollution control is included. Principles of electrostatic precipitation have been developed to the extent that dust removal efficiencies in excess of 99% are now attainable. Results of several air pollution surveys with respect to SO2 and dust concentrations are also discussed.

19034

Austin, H. C. and P. Sedor

COMBUSTION SCHEME CUTS POWER PLANT SMOG COMPONENT. Elec. World, no. 8:51-53, Feb. 19, 1962.

In a search for ways to reduce power plant contributions to smog in the Los Angeles area, two-stage combustion helped considerably with the nitrogen oxide emissions from some types of boilers. By limiting combustion air through the burners to 90% of the theoretical and introducing the remainder of the air through auxiliary air ports in the front wall above the top row of burners, nitrogen oxide concentration in the stack discharge was cut 40% at full load, burning either gas or residual fuel oils. Concentrations formed in power plant boilers depend primarily on the peak temperatures reached during combustion and, to some extent, on the rate of cooling of the combustion gases. From thermodynamic considerations, a reduction in peak temperature from 3700 to 3600 F can reduce the nitric oxide concentration by a third.

19048

Zentgraf, K. M.

THE PRESENT STATE OF FLUE GAS DESULPHURIZATION. (Stand der Abgasentschwefelung). Text in German. Mitt. Ver. Grosskesselbesitzern, 49(1):9-15, Feb. 1969. 11 refs. (Presented to the VGB, Emissions Meet., Salzburg, Bielefeld, and Saarbruecken, 1968).

The activated coal process developed by the firm Hitachi, the Kiyoura-TIT process, using vanadium pentoxide for oxidizing sulfur dioxide to sulfur trioxide and the Mitsubishi process, which converts the sulfur oxides to manganese sulfate, have only been tested with flue gases of oil-fired boilers. Additional equipment is required to use these processes for desulfurization of the dust-laden flue gases of coal-fired steam plants. In the U. S. a pilot plant using the alkalized-alumina-process is presently in operation. It treats 1300 cu m flue gas/hr, with an easily attainable 90% desulfurization. The main problem here is the development of a non-abrasive catalyst. The combustion- Engineering process injecting pulverized calcium products into the boiler is presently being tested in two coal-fired pilot plants with 1600 and 5000 cu m flue gas circulation per hr. Pilot operations using additive suspensions for injection into the boiler which are under way in Germany include the Reinluft process (low-temperature soft coal coke is used as adsorbent), and the Still process. Almost all desulfurization processes are still in the experimental stage. Investment costs run between $11 and $21/kW. In order to keep the operating costs reasonable the sulfur content of the fuel and utilization must be high. The Combustion Engineering and Bischoff processes, which are largely the same, have investment costs running at about $4/kW, but their useful lifetime is short, however.

19189

Kotb, A. K.

ADSORPTION OF SULPHUR DIOXIDE ON COAL. J. Appl. Chem. (London), vol. 20:147-152, May 1970. 6 refs.

A study was made of the feasibility of using coal as an adsorbent material for the removal of sulfur dioxide from stack gases emitted to the atmosphere by different industries. From preliminary results, it would appear that coal is to be favored by a raw materials/cost-effectiveness ratio of 2:1. The work shows semi-quantitatively that the adsorptive capacity of sulfur dioxide on coal varies slightly from one coal to another, and that when coal is re-used through numerous (approximately 40) cycles, its effectiveness as an adsorbent for sulfur dioxide is not greatly reduced. Moreover, this research supports the view that the heating value, ash, sulfur content, etc. of most types of coal changes only slightly after repeated usage as an adsorbent. If, as these findings indicate, coal can initially be used as a sulfur dioixde adsorbent prior to its use as a fuel, economic potential for commercial applications should be enhanced. Empirical equations, developed to correlate the adsorption-desorption characteristics of different coals, can be used as a basis for prediction and comparison by future investigators to further explore this research. (Author abstract)

19261

Moliskey, Anthony

TREATMENT OF PUMICE FOR USE IN FILTERING OUT OBNOXIOUS CONTENTS OF COMBUSTION GASES. (Donald V. Meis and Earl A. Waring, Newport, Wash.) U.S. Pat. 3,513,640. 4p., May 26, 1970. 2 refs. (Appl. Aug. 4, 1969, 3 claims).

The treatment of pumice stone for use in filtering combustion gases is described. The pumice particles are washed free of loose dust and water soluble materials by plain water and then dried. The cleaned particles are carried through a tank of a dilute water solution of paraldehyde or formaldehyde and citric acid. The preferred concentration is one part by volume paraldehyde or formaldehyde in 40,000-50,000 parts of water. To this solution is added one to five parts citric acid for each 10 parts paraldehyde or formaldehyde. In filtering the engine exhaust from a diesel engine, it is best to use pumice particles that have been treated with a solution using 4-5 parts citric acid for each 10 parts by volume paraldehyde or formaldehyde. For filtering the exhaust from a gasoline burning engine, the solution may contain only one part citric acid to 10 parts paraldehyde or formaldehyde by volume. Treated pumice particles can also be used for filtering furnace smoke stacks, mining shafts, and incinerators. The particles retain their ability to filter out obnoxious vapors and gases for several months with no apparent deterioration.

19339

Goldschmidt, K.

FLUE GAS DESULFURIZATION EXPERIMENTS. (Versuche zur Entschwefelung von Rauchgasen.) Text in German. Chem. Ing.-Techn., 40(21-22):1082-1086, 1968. 4 refs. (Presented to the Inst. Chem. Engrs. and the Assoc. Process Engrs., Joint Meet., Brighton, England, 1968).

In a power plant in Ludwigshafen, three desulfurization experiments were conducted: calcium oxide was added to pulverized coal, Ca(OH)2 and Ca(OH)2.Mg(OH)2 were separately injected into a pulverized coal-fired boiler, and lime and dolomite were separately injected into an oil-fired boiler. Addition of calcium oxide to coal caused sintering and excessive soiling of the boiler. The best desulfurization was achieved by injecting Ca(OH)2 into the oil-fired boiler. Sulfur dioxide content in the flue gases sank gradually during the test period, as a CaO layer was deposited which continued to bind SO2 although no new CaO was injected. In the pulverized coal-fired boiler, the SO2 content was rapidly reduced by the desulfurizer but remained constant for the rest of the experiment. When no more additive was injected, the SO2 content rapidly returned to the original level. Dolomite was less effective than Ca(OH)2. The latter additive has more free CaO for reaction with SO2.

19340

Hangebrauck, Robert P. and Paul W. Spaite

POLLUTION FROM POWER PRODUCTION. Preprint, National Limestone Inst. Inc., 21p., Jan. 1970. 9 refs. (Presented at the National Limestone Institute, Inc., 25th Annual Convention, Washington, D. C., Jan. 21-23, 1970.)

Emissions resulting from combustion, especially combustion of coal, are a large and growing factor in increasing air pollution levels. Sulfur oxides, nitrogen oxides, and fine particulate matter will increase several fold over the next three or four decades, even if development of nuclear power generation is extremely rapid, but the most immediate and serious problem is posed by sulfur oxides. Coal cleaning for the immediate future, coal or lignite gasification or conversion for possible application further in the future, and liquefied natural gas importation need attention in fuel resource management. Both 'throwaway' and product-producing processes need rapid development and application. New combustion processes, such as those using fluid beds may make better use of limestone in the dry state. Although combustion design and modification techniques are available for partial control of nitrogen oxides emissions from gas and oil-fired power plants, no control technique for coal-fired plants is under development. Methods of controlling particulates include the use of electrostatic precipitators, with and without mechanical collectors. Scrubbers and fabric filters for use in power plants are being evaluated while dry limestone injection and wet limestone scrubbing processes for control of sulfur oxides will be available shortly. The dry limestone injection process consists of equipment to pulverize limestone, and inject and distribute it into the high temperature furnace gases. It is calcined and reacts with SO2 and oxygen to form calcium sulfate which is collected with the fly ash in the dust collector equipment. The wet scrubbing process is a more likely choice where higher sulfur oxides removal is required. Costs of controlling sulfur oxides are also discussed.

19346

Marquardt, W. and W. Schreiter

PROBLEMS AND PRECAUTIONS FOR MAINTAINING A CLEAN BIOSPHERE IN THE OPERATION OF MODERN POWER PLANTS. (Probleme und Massnahmen zur Reinhaltung der Biosphaere beim Betrieb moderner Kraftwerke). Text in German. Energietechnik, 19(2):53-58, Feb. 1969. 3 refs.

In the German Democratic Republic, the average power plant emits 5 to 25 g dust/cu m flue gas, while to reduce these emissions moder power plants are equipped with electrostatic precipitators with collection efficiencies of 98% or more. Thus, the problem of reducing dust emissions by these plants is considered to be solved, and of far greater importance are the sulfur dioxide emissions. Depending on the type of coal used for firing the boilers, between 10 and 40 tons/h of SO2 are thrown into the air by an average power plant. No economical flue gas desulfurization process has yet been developed. The only other way to avoid dangerous concentrations is to create favorable dispersion conditions. High stacks, high discharge speeds of the stack gas, and utilization of the thermal buoyancy are the measures presently employed to reduce SO2 concentrations in the biosphere. In addition, the site of future power plants must be selected with a view to the most favorable meteorological conditions. Radioactive emissions by nuclear power plants are considered under control. Measurements in the vicinity of the nuclear power plant at Rheinsberg showed that over a period of 14 months only 5% of the maximum allowable values were emitted.

19373

Snow, Robert D.

CONVERSION OF COAL SULFUR TO VOLATILE SULFUR COMPOUNDS DURING CARBONIZATION IN STREAMS OF GASES. Ind. Eng. Chem., vol. 24: 903-909, Aug. 1932. 32 refs. (Presented at the American Chemical Society Meeting, 83rd, New Orleans, La., March 28- April 1, 1932.)

Sulfur distribution during carbonization was studied to develop methods of increasing the proportion of sulfur passing into the gas; such conversion of the coal sulfur to simple volatile compounds would greatly facilitate its ultimate elimination. After a review of previous investigations, experiments are reported in which 15-gr samples of 20-40 mesh coal were heated 4 hours at various temperatures in streams of various gases. The gases and solid residues were analyzed for sulfur. Percentage sulfur eliminations obtained at 1000 C were: nitrogen, carbon dioxide, carbon monoxide, methane, and ethylene, 50 to 60; water gas, 76; anhydrous ammonia, 82; and hydrogen, 87. Steam gave 84%, and water gas with hydrochloric acid gave 72.5% sulfur elimination at 800 C. Partial removal of pyrite by oxidation and leaching, followed by carbonization in hydrogen, gave a sulfur elimination of 93%. Instantaneous carbonization in hydrogen removed 59% of the coal sulfur. (Author abstract modified)

19378

Benner, Raymond C.

METHOD OF PRODUCING ELEMENTAL SULPHUR. (General Chemical Co., New York) U. S. Pat. 1,773,294. 6p., Aug. 19, 1930. (Appl. Jan. 21, 1927, 16 claims).

A process for reducing sulfur dioxide to elemental sulfur by solid or liquid carbonaceous fuel is described. Processes for reducing SO2 by coal or coke have had difficulties in obtaining a product which is not contaminated with soot or solid carbon particles. The presence of soot also makes the condensing and collecting of elemental sulfur difficult. In the process described, SO2 gas is passed through solid incandescent reducing material or liquid fuels. The composition of the resulting gas is adjusted by adding an oxidizing gas, such as SO2, to provide reacting proportions of reducing gas and SO2. This mixture is burned in a combustion chamber maintained at a temperature of 750-1000 C which contains a porous refractory material. In this way, oxidation of the soot or carbon particles with SO2 and carbon dioxide occurs without oxidation of the elemental sulfur. The gas mixture is cooled and the residual gases are contacted with a catalyst to produce additional elemental sulfur.

19380

Haenisch, Emil and Max Schroeder

PROCESS OF OBTAINING SULPHUR FROM FURNACE-GASES. (Assignee not given.) U. S. Pat. 361,761. 2p. April 26, 1887. (Appl. June 10, 1885, 1 claim).

A method of obtaining elemental sulfur from furnace gases containing sulfur dioxide is described. The SO2 is separated from the other gases by contacting it with water in a spray tower; the water absorbs the SO2, but no the other gases. The absorbed gas is separated from the water by heating. The gas is conducted over or through an incandescent bed of coke or coal to be reduced. It is then passed through a chamber containing glowing fire bricks, but no reducing agent. By using this process, only elemental sulfur and carbonic acid are formed.

19394

Francis W. and G. H. Lepper

RECOVERY OF SULPHUR FROM FLUE GASES. Engineering (London), vol. 172:36-37, July 13, 1951.

Four processes for recovering saleable sulfur products from flue gases are described. The production of ammonium sulfate by double decomposition is commercially feasible when boiler house and gas washer are reasonably close together. An alkali-additive process recovers solid sulfur, liquid sulfur dioxide, or sulfuric acid and cement. The recovery of ammonium sulfate and sulfur is a direct process in which solutions of ammonium carbonate are used as the scrubbing agent. Another process uses sodium carbonate as the scrubbing medium, producing sodium sulfite and sulfate. Preliminary cost estimates of recovering sulfuric acid from a large power station burning 2000 tons of coal per day with an average sulfur content of 1.5% would be approximately $20.

19395

Hewson, G. W. and R. Ll. Rees

SOME CONTRIBUTIONS OF CHEMISTRY AND CHEMICAL ENGINEERING TO STEAM GENERATION. Trans. Inst. Chem. Engrs. (London), vol. 17:43-79, 1939. 61 refs. (Presented at the Institution of Chemical Engineers Annual Corporate Meeting, 17th, London, England, Feb. 17, 1939.)

Four problems in the operation of steam power plants are discussed: the evaluation of fuel, the efficient combustion of fuel, the treatment of boiler water, and the removal of sulfur oxides from flue gases. Two different philosophies of SO2 removal are considered in the discussion of the operation of two large steam electric plants. While both handled the SO2 as disposable waste, one was mainly concerned with the absorption of SO2 in water, the absorption in acid condition being aided by the catalytic action of iron. The solution was neutralized as far as possible by the calcium carbonate content of Thames river water, with a final touching-up by scrubbing with calcium carbonate. The other adopted a non-acid treatment, washing with water that was maintained neutral or slightly alkaline. The subject of recovery and sale of sulfur or sulfur products was brought up during the discussion period and mention was made of the extensive and varied approaches to this problem which were in the research or pilot-plant stage. The economics and technical feasibility of coal desulfurization was brought up during the discussion period. Comment was also made to the effect that the United States would have an even more difficult problem in this area than England, since the American coal contained 5 times the sulfur content of Welsh or Scottish coal and the sulfur content was increasing. Comment was also made concerning the lack of public concern on the subject of SO3 fumes in America.

19471

Perry H. and J. H. Field

AIR POLLUTION AND THE COAL INDUSTRY. Trans. AIME (Am. Inst. Mining, Metallurgical, and Petroleum Engr.), vol. 238:337-345, Dec. 1967. 14 refs.

Legislation intended to limit emissions of pollutants or the type of fuel that can be utilized, particularly as it applies to the coal industry, is reviewed. Emission limits of various codes and regulations are tabulated. Effluents from coal operations include sulfur oxides, nitrogen oxides, hydrocarbons, carbon dioxide, smoke, and flyash. The nature and magnitude of air pollution problems affecting the mining, preparation, coking, and combustion of coal are described. Application of various particulate control devices, including electrostatic precipitators, and cyclones, is discussed. Nitrogen oxides can be controlled by excess or secondary air and by catalytic decomposition. Sulfur oxide emissions can be controlled by using low-sulfur fuel, improved combustion efficiency, alkaline additives, scrubbers, and desulfurized fuel. Methods of partial and complete desulfurization of fuels are reviewed. Processes for the specific removal of sulfur dioxide include absorption, alkaline additives, Reinluft process, catalytic oxidation, and alkalized alumina.

19475

Tyrer, Daniel

PRODUCTION OF SULPHUR. (Imperial Chemical Industries Ltd., London (England)) U. S. Pat. 1,936,809. 1p., Nov. 28, 1933. (Appl. June 19, 1931, 2 claims).

The production of sulfur by reducing sulfur dioxide with carbon at a high temperature is described. An SO2 gas containing no oxygen or an amount insufficient to maintain the necessary reaction temperature is passed through a bed of coal. Coal may be supplied to the top of a fuel bed whose lower portions are maintained at a temperature of 100-1200 C by the introduction of air. Hot SO2 is admitted at the top and passes downward through the bed, carbonizing the coal. The gaseous products are then passed through a heated zone near the air supply where the reduction of SO2 is completed. The temperature of the inlet gas should be at least 400-500 C. If the gases leaving the fuel bed contain an excess of carbon monoxide, it may be utilized by adding more SO2 which causes a secondary reaction. In general, the gaseous reaction products will also contain small amounts of hydrogen sulfide, which may be eliminated by mixing the gaseous products with the requisite amount of sulfur dioxide.

19480

Rauscher, J. A., H. Acton, and R. F. Barut

NEW PROCESS STABILIZES IN THE FORM OF SULFURIC ACID THE SULFUR OXIDES CONTAINED IN SMOKE. (Nouveau procede valorisant sous forme d'acide sulfurique les oxydes de soufre contenus dans les fumees). Text in French. Ann. Genie Chim., 1967:159-161. (Presented to the Congr. Intern. du Soufre, Toulouse, 1967.)

A new process for recovering sulfuric acid from sulfur oxides present in smoke from steam-generating stations consists essentially in removing the fly ash content of the flue gas from the boiler. About 90% of the SO2 is next oxidized to SO3 by passage through beds of vanadium catalyst. The flue gases are then cooled by heat exchange with combustion air, causing a weak sulfuric acid mist to form. The mist is collected by a high-efficiency Brink-Mist eliminator. The acid can be sold as produced or concentrated, depending on the acid strength collected and the requirements of the market. After treatment, the gases exhausted to the atmosphere contain 0.01 to 0.03% SO2. Estimates are that a 500,000 kw power plant will produce 500 tons per day of 100% sulfuric acid at a concentration of 78%. Investments for such a plant will be 15-30% the cost of the power plant.

19482

Klimecek, R.

A CZECHOSLOVAKIAN PROPOSAL OF AMMONIACAL FLUE GAS DESULPHURIZING FOR A 100 MW POWER PLANT. Ann. Genie Chim., 1967:175-179. (Presented to the Congr. Intern. du Soufre, Toulouse, 1967.)

The amounts of flue gases from high-capacity thermal power plants in Czechoslovakia are of the order of millions cu m/hr. The bicyclical ammonia scrubbing method proposed to treat these high quantities is described. After prior cooling to 25 C and dust extraction, the smoke is washed in two stages by an aqueous ammonium sulfite-bisulfite solution and is then returned to the atmosphere with a residual SO2 and ammonium content of less than 0.01% by volume. The SO2 enriched washing liquid undergoes thermal regeneration by steam. After elimination of part of the SO2 by desorption, and elimination of the (NH4)2SO4 by crystallization at 35 deg, the liquid is recycled. The SO2 freed during the thermal regeneration is cooled, dried, and liquefied for compression. The method is designed for an industrial unit with a power of 100 MW. Since investment and operating costs are expected to be high, successful utilization of the method will depend on finding markets for the ammonium sulfate and liquid SO2. (Author abstract modified)

19541

Lindblad, Axel Rudolf

PROCESS FOR PRODUCING SULPHUR BY REDUCING SULPHUR DIOXIDE. (Assignee not given.) British Pat. 426,456. 4p., April 3, 1935. (Appl. June 12, 1934, 9 claims).

A process for producing elemental sulfur by reducing the sulfur dioxide contained in furnace gases is described. A gaseous mixture containing SO2 and oxygen is fed into a gas producer containing coal or coke. The speed of the gas and the temperature in the producer are regulated so that the gases formed consist mainly of carbon monoxide. This gaseous mixture is then contacted with SO2. The coal or coke in the producer is maintained in continuous movement by a rotary grate. This causes friction of the charge pieces against one another so that the ash formed is continuously removed and fresh surfaces are always available for reaction with the SO2. The gas mixture from the producer and the SO2 are passed through a catalyst-filled chamber. A suitable catalyst is brick coated with an iron compound or an alkali metal compound. If any impurities are contained in the gas, it is recommended that they first be purified by cooling so that the impurities are condensed and then passing them through an electrostatic precipitator.

19560

Bacon, Raymond F. and Isaac Bencowitz

RECOVERY OF SULPHUR. (Assignee not given.) U. S. Pat. 1,917,685. 5p., July 11, 1933. (Appl. July 29, 1930, 8 claims).

A method for producing elemental sulfur from the sulfur dioxide contained in roaster or smelter gases is described. It has been proposed to recover elemental sulfur from SO2 by passing the gas through beds of incandescent coke. This process, however, had little commercial success due to technical and economic problems. With proper control of the temperature of the reacting materials, the rate of gas flow, and other factors, a high yield of elemental sulfur can be obtained by treating smelter gases with reducing gases or powdered coal. The gas is led to a reaction chamber where preheated reducing gases are maintained at a temperature of approximately 1000 C or above. Exothermally reacting gases are rapidly passed throuh the reaction chamber to help maintain the temperature while the exit gases are rapidly cooled to below 500 C to inhibit the formation of sulfur compounds. Elemental sulfur is condensed and separated from the cooled gases. The residual gases are contacted with a material that will promote the oxidation of hydrogen sulfide and carbon oxysulfide to elemental sulfur.

19581

Kamino, Yasumi, Shigenori Onizawa, Kenji Yasuda, Masaaki Miyaji, Yoshihide Kawamura, and Akira Inoue

REMOVAL OF SO2 IN EXHAUST GAS BY THE STEAM-GENERATED ACTIVATED CHARCOAL PROCESS (I). REPEATED ABSORPTION-DESORPTION EXPERIMENT AND ECONOMIC EVALUATION OF THE PLANT. Hitachi Shipbuilding Co. (Japan), p. 1420, 1969 (?). Translated from Japanese. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 2p., Oct. 30, 1969.

In bench-scale tests of the steam-generated activated charcoal process, the removal rate of sulfur dioxide was observed with and without air treatment. The air treatment, which comes between the desorption and absorption states, consists of passing air containing water at 100-200 C through the absorption-desorption tower for one hr, followed by dry air for 30 min. The treatment enabled the charcoal to absorb 90% of the sulfur dioxide even after repeated use. The apparatus and operating conditions required for application of the activated charcoal process to a 250,000 kWH power plant are noted.

19602

Charmbury, H. B.

TECHNICAL REPORT ON THE PROGRESS MADE ON THE ELIMINATION OF AIR POLLUTION FROM BURNING REFUSE PILES PROJECT. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y., Anthracite Div., 14p., 1963. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers Meeting, April 1963.)

One of the most serious air pollution problems today is the burning of combustible material in mine refuse piles. To eliminate the pollution, it is sought to remove the source, the combustible material. The resulting separation would yield a clean, non-burning refuse and a low-grade fuel. Progress of research being conducted that will establish the amount and nature of the combustible material contained in the refuse piles and will establish, by special tests, the nature and characteristics necessary to have a non-burning refuse is reported. Samples from anthracite and bituminous coal areas were subjected to sink-float tests in heavy liquids. After the sink-float samples were dried and weighed, they were crushed, ground, and moisture, ash, sulfur, and BTU determinations were performed on all fractions. Three washability examinations were completed on bituminous coal refuse and one on an anthracite coal refuse. The large number of washability results obtained led to the development of a time saving computer program to make the necessary calculations. Cumulative float and cumulative sink calculations and composite calculations were obtained from direct weight percent, ash, sulfur, and BTU values. A special test was developed to establish the burning characteristics of refuse material. Numerous preliminary tests were performed with an ignition temperature furnace. This included several tests with an inert(limestone). In these tests, information was sought concerning the influence of air flow and size and the degree of reproducibility. Future plans call for an automatic multipoint recorder and a second furnace to permit 24 hour per day operation. The results obtained by the washability studies and by the ignition temperature studies will be used as the basis for the design and lay-out of an experimental mobile preparation plant which will have a capacity of 100 tons per hour.

19608

THE ELIMINATION OF SULPHUR FROM FLUE GASES. Engineering (London), vol. 146:499-501, Oct. 28, 1938.

The treatment of stack gases from two powerplants in England is discussed. At the Battersea station, the gas is washed by water from the Thames, the sulfurous acid being oxidized to sulfuric acid, and this acid is neutralized by the natural alkalinity of the Thames water. The Fulham power station employs a packed tower type gas washer, with calcium-sulfate crystals added to the lime water to inhibit deposition. If the recovered products can be sold, they will more than pay for the cost of the process. The problems and difficulties encountered in setting up the Fulham station are discussed.

19619

Ketov, A. N., V. V. Larikov, V. V. Pechkovskiy, and A. S. Shligerskiy

DRY LIME METHOD OF REMOVING SULFUR DIOXIDE FROM POWER STATION FLUE GASES. (Sukhoy izvestkovyy sposob ochistki topochnykh gazov tets ot sernistogo angidrida). Text in Russian. Zh. Prikl. Khim., 41(4):724-729, 1968. 3 refs.

It was demonstrated experimentally that a 50-60 % removal of sulfur dioxide from flue gases can be achieved by stoichiometric addition of dry lime to the furnace charge when burning coal at 1100-1200 C. An excess air factor of 1.15 and a lime consumption at 10-20% above the stoichiometric value are recommended for this method (lime analysis (%): CaCO3, 83.8; MgCO3, 1.7; CaSO4, 0.8; R2O3, 0.5; SiO2 plus insoluble ash, 13.2).

19629

Chertkov, B. A.

COEFFICIENTS OF MASS TRANSFER DURING ABSORPTION OF SO2 FROM GASES BY SOLUTIONS OF AMMONIUM SULFITE AND BISULFITE. (Koeffitsienty massoperedachi pri pogloshchenii SO2 iz gazov rastvorami sul'fitbisul'fita ammoniya). Text in Russian. Zh. Prikl. Khim., 37(11):2437-2455, 1964. 11 refs.

Data are analyzed for the sulfur collecting installation at a thermoelectric station to confirm the validity of calculating the coefficient of mass transfer using a Nusselt number (for gas) of 0.0035Re(gas)Re(liquid) to the 0.4th power (Re is Reynolds number). This value is established as general for all cases of absorption of SO2 by alkaline absorbers. The widely accepted belief that the overall coefficient of mass transfer decreases with increased diameter of the absorption column is not substantiated; it does, however, decrease as the saturation of the absorbing solution increases and approaches equilibrium with the gas being absorbed.

19642

Land, George W., Eino W. Linna, and William T. Earley

CONTROLLING SULFUR DIOXIDE EMISSIONS FROM COAL BURNING BY THE USE OF ADDITIVES. Preprint, Air Pollution Control Association, New York City, 33p., 1969. 4 refs. (Presented at the Air Pollution Control Association Annual Meeting, 62nd, New York, June 1969, Paper 69-143).

A project is reported in which 20 tests with five coal additives - dolomite chips and pulverized dolomite, hydrated lime, aragonite (a high-calcium limestone), red mud (an aluminum by-product high in iron oxide), and a proprietary liquid combustion catalyst were run in an operating industrial boiler plant to study their effects on sulfur dioxide emissions. The test unit was a 750-HP Wickes boiler fired by a multiple-retort underfeed stoker. Two methods were used: the additive was either mixed with the coal before it was fired, or was injected with compressed air jets over the fire. Sampling techniques for suspended particulates, using a gravimetric sampling train, and for SO2 in the stack gases, are described. Results are presented and discussed; in general they were anomalous, and because the tests were limited in scope and subject to numerous uncontrolled variables, no conclusions are drawn. The results do however, indicate that SO2 emissions from coal burning can be significantly reduced by the use of certain additives, and that further studies are warranted.

19670

Anderson, William Carrick

A CYCLIC PROCESS FOR THE REMOVAL OF OXIDES OF SULPHUR FROM WASTE GASES. (Assignee not given.) Brit. Pat. 438,582. 2p., Nov. 19, 1935. (Appl. June 26, 1935, 6 claims).

A method of removing sulfur dioxide from the waste gases of furnaces in which coal, coke, oil, and gas are burned is described. The cooled gases are contacted with a suspension or solution of magnesium in water. The SO2 is converted to magnesium sulfate and a small proportion of magnesium sulfite. Thus, the SO2 becomes fixed in the solution and the purified gases escape. It is preferred that the gases be contacted with the magnesium solution by passing them through or over screens of absorbent material. The screens are kept moistened by dipping them into the solution or by spraying. The magnesium sulfate and sulfite remain dissolved and may be separated by crystallization. The magnesium sulfate is dehydrated and heated with 25% of its weight of carbon to a red heat in a hydrogen-containing atmosphere. This treatment causes a reaction which liberates sulfuretted hydrogen and regenerates the magnesium. The gases containing sulfuretted hydrogen are passed into a magnesium bisulfite solution. Elemental sulfur is precipitated out and can be separated by filtration or settling. Small amounts of polythionate and polythionic acids remain in solution.

19672

Benner, Raymond C. and Alfred Paul Thompson

PROCESS FOR THE RECOVERY OF SULPHUR FROM SULPHUR DIOXIDE. (General Chemical Co., New York, N. Y.) U. S. Pat. 1,836,357. 7p., Dec. 15, 1931. (Appl. Nov. 2, 1927, 5 claims).

A process for reducing sulfur dioxide to elemental sulfur is described. A mixture of SO2, in an amount not greater than 12%, and oxygen is contacted with a fuel, such as coal or coke, at an elevated temperature. The proportion of the SO2 and oxygen are regulated by the addition of air so that substantially all of the carbon is used to produce carbon monoxide. Sulfur dioxide gas is added to the gaseous products of the reduction reaction to provide interacting proportions of reducing and reducible gases. This SO2 gas is richer in SO2 and poorer in free oxygen than the gas entering the reduction chamber. The interaction of the reducing gases and the SO2 forms elemental sulfur, water, carbon dioxide, and CO. The products are cooled to as low a temperature as possible without causing condensation of the sulfur, and passed to a catalytic chamber. The elemental sulfur is then condensed and collected. If the residual gases contain any sulfur compounds, they may be contacted with activated carbon to remove the last traces of these compounds and any elemental sulfur present.

19678

Tyrer, Daniel

PRODUCTION OF SULPHUR FROM SULPHUR DIOXIDE. (Imperial Chemical Industries, Ltd., London (England)) U. S. Pat. 1,908,873. 3p., May 16, 1933. (Appl. June 10, 1931, 1 claim).

The production of sulfur from sulfur dioxide by reduction with carbon at a high temperature is described. High temperature coke had been used as a reducing agent, but it has been found that low temperature coke, or semi-coke offers advantages due to its greater activity. Thus, reaction temperatures lower than with high temperature coke, or from 600-800 C, may be used. Heat of the reduction gases also may be used to carbonize coal, and thus produce semi-coke for the reduction process. The reduction of SO2 by semi-coke may be conducted in any suitable manner. The gas may be passed through a bed of lump semi-coke which has been externally heated or heated by the passage of sulfurous gas and air. Granualr or pulverized semi-coke may also be used. The gas may be forced through a bed of the material so as to cause a turbulent motion, or the pulverized semi-coke may be dispersed in the SO2 and the mixture exposed to a high temperature.

19692

Supp, A., J. Hartwig, and W. Schnuerpel

DESULFURIZATION OF SOFT COAL, ESPECIALLY COAL WASHINGS. (Entschwefelung von Steinkohle, insbesondere von Kohlenschlaemmen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:412-417, 1970. 2 refs.

Research originated by the bituminous coal industry has indicated the practicality of reducing the sulfur content of coal mined in the Ruhr by an average of 40-60%. Extensive experimentation was also conducted with the use of a coal-water suspension as a fuel for use in power plants. This has increased interest in the desulfurization of such suspensions. A device for mechanically desulfurizing a suspension of particles containing pyrite consists of a combination of a stirring mechanism and 'cage' made up of hollowed-out rings. This element is rotated at a predetermined speed, which causes particles with the specific gravity of pyrite to be selectively precipitated from the suspension. A pilot plant making use of this principle has a throughput rate of 8 tons per hour for a turbidity of 500 grams per liter and of 12 tons per hour for a turbidity of 750 grams per liter. It uses an electrical input of 60 kW. Results of testing show the possibility of a 40-60% sulfur removal, combined with a 20-40% separation of sulfur-bearing ash. A certain amount of good coal is lost in the process, 5-7% wt. By using a two-stage desulfurization process, it is possible to diminish this loss to less than 1%. It is even possible, by further purification, to obtain a commercial pyrite concentrate, the yield varying between 77 and 90% wt. Best results are obtained with a grain size 40-100 microns. The operating cost of this process has been estimated at approximately $.40 per ton.

19724

Brivio, Luigi

USE OF HIGH-YIELD MULTISTAGE CYCLONE DUST FILTERS TO PURIFY FLUE GASES FROM HEATERS USING SOLID OR LIQUID FUELS. (Impiego dei depolverizzatori multiciclonici ad alto rendimento per la depurazione dei fumi di caldaia funzionanti a combustibili solidi o liquidi). Text in Italian. Termotechnica (Milan), vol. 22:27-28, 44, 1968.

A new cyclone dust filter is capable of differentiating the velocity of particles to be separated according to their granulometric size. Thus the speed of particles with a lower mass can be more closely adjusted to the speed of the transporting fluid, permitting a higher degree of assimilation, while larger particles are slowed down in proportion to their mass, minimizing the problem of wall erosion which is more intense in the case of larger particles. Such a filter is ideal for use in heating systems that employ an unpulverized solid fuel, but is less efficient when the fuel used is in a powdered form. This type of dust separator is also the most advantageous for use with liquid fuels or in cases where the coarser dust particles must be removed but the escape of very fine particles is not considered dangerous to the environment. The new filter system is economically advantageous for smaller plants, whereas for giant power plants or heating plants, the use of electrostatic precipitators become practical. The multistage cyclone is less efficient when there are wide variations in the load carried, a difficulty overcome by the use of a modulated control system, which maintains a constant dust load by recycling, as needed, a portion of the exhaust gases that have already been purified. The cyclone should be used in conjunction with an auxiliary fan, so as to compensate for the reduction in natural draft, which if uncompensated would increase the degree of incomplete combustion. With these factors taken into consideration, the new device is suitable for use in any sort of plant that consumes 1-50 kg per hour of liquid fuel.

19733

Shibler, B. K. and M. W. Hovey

PROCESSES FOR RECOVERING SULFUR FROM SECONDARY SOURCE MATERIALS. Bureau of Mines Information Circ., no. 8076, 1962, 62p. 561 refs.

A literature survey on processes for recovery of elemental sulfur and sulfur compounds from secondary source materials is presented, and the more important processes from all non-Frasch sources are described. The text consists of concise descriptions of the general nature of the recovery processes and definitions of major differences between processes proposed for treating the same or similar materials. The bibliography represents the available English language literature on the subject through 1958, with emphasis on the period 1950-1958. In addition to several articles and publications containing general information on sulfur, the text and bibliography on processing methods are arranged under the six principal sources of secondary sulfur, as follows: volcanic sulfur, including all elemental sulfur deposits not adaptable to the Frasch mining process; hydrogen sulfide as found in sour natural gases, petroleum refinery products, and coke-oven gases; sulfur dioxide from the roasting and smelting of metal sulfide ores and from power plant waste gases; pyrite and pyrrhotite obtained by mining mineral deposits or produced as by-products from the concentration of sulfide ore; gypsum and anhydrite occurring as deposits of calcium sulfate; and industrial wastes containing sulfates, sulfites, and sulfuric acid, such as those produced in the steel, paper, and petroleum industries. (Author summary modified)

19803

Hausberg, G.

THE BISCHOFF PROCESS. (Das Bischoff-Verfahren). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:121-127, 1970.

Problems of waste-gas purification occasioned by ever-increasing production quotas for electric power plants call for new research on the removal of dust and sulfur dioxide. Plant economics demands a process which simultaneously removes SO2 and particulate pollutants, requiring a new investigation of the use of wet processes, previously neglected because of the threat of draft loss and increased maintenance costs resulting from the clogging of equipment that accompanies such processes. Tests were conducted early in 1968 on a two-stage scrubber, 5,000 cu Mn/hr throughput capacity, used in conjunction with a power plant boiler. The effect of the scrubbing process was observed for various combinations of fumes and dust. A maximum pressure loss of 300 mm H2O was observed, and the consumption of scrubbing liquid was held constant. Results indicated that a realistic goal was 80% removal of SO2, with a dust content of less than 50 mg/cu Nm in the purified gas. A pressure loss in the scrubber of about 250 mm H2O was considered acceptable. For final test concentrations of 100-150 mg, the pressure loss need be only 150-200 mm. It has been estimated that for dust and SO2 removal in a 350 MW block, the additional cost is $.01 per kWh, depending on the type of desulfurizing material used. Depending on the adjustments made, this process is capable of dust removal to a level less than 100 mg/cu Nm, including the removal of fine dust particles that normally escape as emissions. The SO2 removal amounts to 80-90% when its concentration in the original flue gas is about 2.5-3.0 g/cu Nm. The flexibility of the apparatus is seen from its rapid adjustment to variable operating conditions, such that a boiler out of operation overnight can be brought up to its full capacity within half an hour, and the equipment is insensitive to load fluctuations.

19804

Lemke, K.

DESULFURIZATION OF SOFT COAL. (Beitrag zur Frage der Entschwefelung von Steinkohle). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:405-411, 1970.

An important mineral component of soft coal is iron pyrite, whose sulfur content (about 53%) is a principal source of the sulfur dioxide content of flue gas, although about 0.8% of the sulfur belongs to organic compounds and cannot be removed by mechanical or electrical processes. Attempts have been made to be more selective in the coal mining process itself, by using coal that has a lower sulfur content, but except in extreme cases such selectivity is not economical. Attention is given to the following factors, in terms of concrete examples: grain size and separability of pyrite; separation of pyrite from middlings; wet and dry processes for separating pyrites from middlings as this relates to the milling of coal for power plant use; the possibilities of separating pyrite by a magnetic process. Pyrite separation from middlings is feasible, provided the content of grains less than 0.06 mm is not too high. The pyrite content of most coal mined in West Germany has a grain size of 0.02-0.6 mm, most of it unbound or loosely bound to the coal itself. The basic problem is one of screening the original particles in such a way as to eliminate a large percentage of pyrite. Experiments with a Frantz magnetic separator show that a fuel strength of 14,000 Gauss will remove about 65% of the pyrite from untreated samples, and that increased fuel strength does not improve efficiency. When the pyrite is heat-treated at 300 C, 17,000 Gauss are required for complete removal of pyrite from the cooled samples. With a treatment temperature of 500 C, a fuel strength of only 4900 Gauss is required to obtain the same results.

19834

Paretsky, Leon, Louis Theodore, Robert Pfeffer, and Arthur M. Squires

PANEL BED FILTERS FOR SIMULTANEOUS REMOVAL OF FLY ASH AND SULFUR DIOXIDE: II. FILTRATION OF DILUTE AEROSOLS BY SAND BEDS. Preprint, Air Pollution Control Association, New York City, 26p., 1970. 6 refs. (Presented at the Air Pollution Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-29.)

Experimental studies of the filtration of dilute aerosols of Dow microspheres by beds of sand are reported. The experiments were conducted with flows passing vertically upward, vertically downward, and horizontally. The results were correlated reasonably well by semi-empirical, semi-theoretical considerations taking into account collection by diffusion, gravity settling, direct interception, and inertial impaction. The results are preliminary to experiments to be made on filtration of aerosols by a filter cake of fly ash resting upon a sand bed. An effective filter of this type could be used to reduce fly ash and sulfur dioxide emissions from power generators. The experimental results show that a velocity of maximum penetration exists. Reduction of the aerosol filtration data to single particle collection efficiencies indicates that there is no effect of bed height on the single particle collection efficiency. Experimental single particle collection efficiencies are larger for the finer sand. At low velocities, the primary means of capture is by diffusion, the influence of which decreases as the velocity increases. The 'free surface model' predicts that collection by Brownian diffusion depends only on the dimensionless Peclet number and a complex function of the bed porosity. The effect of gravity settling is superimposed on the other mechanisms. Gravity settling is an appreciable effect at velocities less than 1 cm/sec for the 1.1 micron polystyrene aerosol, but its influence decreases with increasing velocity. Gravity settling is responsible for the difference in the upshot and downshot efficiencies at low velocities. For a given size aerosol it is independent of sand size. Filtration efficiencies of aerosols by direct interception can also be predicted using the free surface model. The influence of direct interception is independent of velocity and depends only on aerosol and collector size, and be porosity. Prediction of single particle efficiencies by inertial impaction using the free surface model confirms the existence of a critical value of the inertial parameter, and is in agreement with the value reported in the literature for a voidage. The critical inertial parameter decreases with decreasing porosity.

19845

Domahidy, George

FUEL BURNING PROCESS AND APPARATUS. (Combustion Engineering, Inc., Windsor, Conn.) U. S. Pat. 3,320,906. 4p., May 23, 1967. 5 refs. (Appl. April 20, 1966, 7 claims).

A method is described for removing sulfur compounds and particulates such as dust particles and fly ash from flue gases of steam generating and similar equipment. The furnace portion contains a plurality of burners which feed a mixture of pulverized coal and primary combustion air into the furnace chamber. Limestone or dolomite is injected into the flue gases to react with the sulfur compounds. A wet scrubber promotes the reaction and removes the reaction products and other particulate matter from the flue gas stream. The gases are reheated after wet scrubbing to prevent any visible plume or localized pollution due to the low temperature nonbuoyant gases issuing from the scrubber.

19874

Tyrer, Daniel

IMPROVEMENTS IN THE PRODUCTION OF SULPHUR. (Imperial Chemical Industries Ltd., London (England)) Brit. Pat. 358,580. 3p., Oct. 12, 1931. (Appl. July 11, 1930, 5 claims).

An improved method of reducing sulfur dioxide by coal for the production of sulfur is presented. Sulfurous gas containing no oxygen or an amount insufficient to maintain the reaction temperature is preheated to at least 400-500 C and passed downwardly through a layer of coal at the top of a relatively deep fuel bed. The gaseous products, including those arising from distillation of the fuel, then pass through an intermediate layer of coke, produced by the carbonization of the coal, where the temperature is maintained at 1000-1200 C by the introduction of air from tuyeres. Here the tars are cracked and any residual SO2 is reduced. The resulting gas is withdrawn at a point below that at which the air is introduced.

19876

Griffith, Roland Hall

IMPROVEMENTS IN OR RELATING TO THE CONVERSION OF CARBON DISULPHIDE TO SULPHUR. (Gas Light and Coke Co., London (England) Brit. Pat. 449,710. 3p., July 2, 1936. (Appl. April 5, 1935, 9 claims).

In the purification of gases such as coal gas by an oil washing process, considerable quantities of carbon disulfide are obtained as a by-product. The carbon disulfide, which is difficult to handle and transport, can be converted to liquid sulfur by mixing it with SO2 and reacting the mixture at 180-250 C with a titanium, thorium, uranium, cerium, silicon, tungsten, or vanadium catalyst. The catalyst is introduced into the reaction in its oxide form but (with the exception of silicon oxide) is converted to its sulfide form at the commencement of the reaction. A portion of the recovered sulfur can be burned to form further SO2 for use in the process.

19972

Central Electric Experimental Station (Japan), SO2 Specializing (Limited) Dept

EXPERIMENTAL REPORT ON THE ELIMINATION OF SULFUROUS ACID GAS BY INJECTION OF LIMESTONE AT MIE POWER STATION. (TEST RESULTS OF LIMESTONE INJECTION AT MIE POWER STATION). Oct. 25, 1967. Translated from Japanese. Belov and Associates, Denver, Colo., 57p., May 15, 1970.

The results of a series of tests to determine the ability of limestone powder to remove sulfur dioxide from power plant effluent are discussed. Various conditions, such as making the injection particles as small as possible, using limestone with 1% or more iron content, scattering the powder evenly in the boiler, and placing injection points on the chimney where the temperature is between 1000-1200 C, greatly enhanced the rate of removal. With a ratio of limestone to crude oil of 15% by weight, the removal efficiency is 50-60%. Dust accumulation on the interior walls of the boiler, and especially on the reheat tube, is great. Further work is required to eliminate this problem. (Author abstract modified)

20035

Johnstone, H. F.

THE ELIMINATION OF SULPHUR COMPOUNDS FROM BOILER FURNACE GASES. PART I. Steam Eng., 1932:153-154, Jan. 1932. 5 refs. PART II. Ibid, 1932:208-211, Feb. 1932. 1 ref. (Presented at the Third International Conference on Bituminous Coal at the Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 1931.)

Methods for removing sulfur dioxide from flue gases are reviewed with particular attention to scrubbing in the presence of a cayalyst; promising results with iron and manganese compounds are reported. Experiments were conducted with 0.325% SO2 in air bubbled through 2 liters of water and a cayalyst at a rate of 0.7 cu ft/min; contact time was no more than 4 sec. Inhibitory effects of phenols, salts of copper and tin, and hydrogen sulfide in concentrations of more then 0.2% in the gas were noted. Additional studies were made to determine the effects of catalyst concentration, temperature, and presence of inhibitors on scrubber efficiency; in this case, contact time was reduced to 3 sec. The iron catalyst was found to be less affected by inhibitors than manganese. A 100 cu ft pilot scrubber was operated with an initial SO2 concentration of 0.1% and a contact time of 0.05 sec; 270 gal of water per ton of coal were required.

20053

Ehrlich, Shelton

AIR POLLUTION CONTROL THROUGH NEW COMBUSTION PROCESSES. Environ. Sci. Technol., 4(5):396-400, May 1970.

More than 6000 megavolts of new coal and oil-fired power generating capacity will be brought on line in 1970, and combustion at an elevated pressure is proposed to reduce oil process sulfur oxide emissions from these yet unbuilt boilers. Fuel would be burned at a pressure of 8 atmospheres in one design concept for a 480 megavolt power station. Fewer boiler tubes are need to absorb heat from high pressure gas than from a hot gas at atmospheric pressure which would improve capital cost, while efficiency improvement arises from the power generated by the gas turbine in excess of that required to compress the combustion air. A sulfur oxide removal process for such a high pressure boiler would handle only one-eighth the volume of gas of an equivalent atmospheric pressure boiler and consequently treat it more intensively. Supercharging does not appear to be an immediate prospect for coal, but fluidized-bed combustion of coal at atmospheric pressure and the removal of sulfur oxides before or as they are formed does have immediate potential. Combustion rate may be five times the value of that in a conventional boiler, and effective average heat flux into the boiler tubes may also be five times as high. Combustion takes place at temperatures low enough (1600 F) to preclude the formation of corrosive ash compounds that tube metals may be less costly, and peak heat flux may be two thirds that found in a conventional boiler with thinner tubes of lesser alloys required. The Ignifluid boiler was developed in France as a very effective fluidized-bed combustor with a moving grate for ash removal.

20073

Bouilliot, Robert

EXPERIMENTAL STUDY OF THE EFFECTS OF RECYCLING FUMES ACROSS A LAYER OF ANTHRACITE BURNED OVER A FIXED GRATE. (Etude experimentale des effets du recyclage des fumees a travers une couche de grains d'anthracite en combustion sur grille fixe). Text in French. Rev. Gen. Thermique (Paris), no. 98:139-155, Feb. 1970. 3 refs. (Presented at the journees de la combustion 'Verbrennung und Feuersengen', Karlsruhe, Germany Sept. 18-19, 1969.)

The effects of recycling were measured in an experimental hearth consisting of a crucible with an inner diameter of 200 mm fitted with a grate of 6 mm cylindircal steel bars spaced 6 mm apart, on which the anthracite was placed. The effects of the recycling consist of an important change in the temperature profile in the layer, an important decrease in the carbon monoxide content of the fumes and a slight increase in the carbon dioxide content, a slower extinction of the layer, a noticeable decrease in the rate of combustion-gasification, especially during the extinction period, and a greater amount of unburned residue. The industrial significance of the findings might be summarized as follows: the process produces a temperature profile in the layer more favorable to a longer period of service and construction with less costly materials; decreased temperatures in the bed and the almost complete absence of CO, which raises the melting point of silicates, inhibits the fusion of the minerals, and reduces the total effects in the amount of clinker, which is detrimental to the material of which the hearth is made; and reduces the problem of the release of CO into the atmosphere.

20082

Exley, L. M.

A PRACTICAL REVIEW OF RESIDUAL OIL FIRING PROBLEMS AND SOLUTIONS. Combustion, 41(9):16-23, March 1970. 9 refs.

Power-plant boilers firing residual fuel oil are discussed with respect to fireside corrosion and boiler slagging, cold-end corrosion, and air pollution. Most residual fuels contain vanadium, sodium, and sulfur compounds. Upon combustion, these elements form low-melting ash deposits on superheater and reheater tubes, supports, hangers, and spacers. Corrosion usually occurs with steam temperatures above 1000 F, but wastage has been reported at 950 F. In the low-temperature superheater section, SO3 is catalytically generated. Sulfuric acid is formed by condensation at the cold end of a boiler as the gases encounter cooler metal temperatures. When flue-gas temperatures approach the acid dewpoint and condensation occurs, ash particles agglomerate and eventually pass out of the stack. Under these conditions, the surrounding area is subjected to fallout of greenish acid deposits, small black particles, or even large masses of highly corrosive material. Fireside corrosion can be eliminated and formation of SO3 inhibited by adding magnesium oxide to the fuel oil. The MgO reacts with vanadium to form a dry and noncorrosive ash, while poisoning the catalytic effect of vanadium in converting SO2 to SO3. A coating of MgO on water wall tubes makes it possible to operate boilers on much lower excess air. In combination with MgO additives, low-excess air firing eliminates acid smut fallout by lowering acid dewpoint. For a unit burning 10,000 bbls/day, a decrease of excess air from 20 to 5% can result in a saving of $73,000 per year.

20097

Hashimoto, Kiyotaka

THE POINT OF PLANNING AND ITS EFFECT ON OPERATION RESULT OF AN ELECTRIC PRECIPITATOR IN VARIOUS INDUSTRY SMOKE ABATEMENT (III) TREATMENT FOR WASTE GAS OF A COMBUSTION FURNACE AT A THERMAL POWER PLANT (II). (Gyoshubetsu ni miru denkishujinsochi no setsubikeikaku to untenkoka (III) - karyokuhatsudensho no nenshoki haigasu no shori (sono II)). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 2(10):701-707, Nov. 15, 1966. 11 refs.

Several factors can cause the electrical resistance of dust in the waste gas of a powdered-coal burning boiler to vary considerably. When the resistance is too high, the discharging condition in an electric precipitator becomes unstable. Several methods of reducing the electrical resistance of dust are mentioned. The amount of dust in the hopper should be periodically checked and removed as a precaution against accidents. The problems encountered with rapping on the electrodes of an electric precipitator are also discussed. The matters of primary concern in heavy oil burning for thermal power generation are injury from sulfur dioxide, sulfur trioxide, smut, or plume. To prevent injury from SO3, the sulfur in heavy oil should be removed before burning; but at present, no economical methods are available. Since SO3 is contained in fine dust, a combination of an electric precipitator and a cyclone should be used as a dust collector for a heavy-oil-burning boiler. Due to the special properties of the dust, some problems arise when operating the precipitator.

20141

FLUE GAS WASHING AT BATTERSEA. PART I. Eng. Boiler House Rev., 47(2):90-96, Aug. 1933. PART II. Ibid., 47(3):162,164, Sept. 1933. (Presented at the 52nd Annual Meeting of the Society of Chemical Industry, Newcastle-on-Tyne, England, July 11, 1933.)

Details of the flue gas washing installation for sulfur oxide removal at the Battersea Power Station in England are described. The gas from coal contains about 1% sulphur; it is washed with water during its passage through scrubbers in which both the gas and water are brought into contact with iron oxide. The gas is then scrubbed, preferably in contraflow, with water in another chamber; the scrubbers consist of an inert material such as wood. After passing upwards through the water sprays, the gas enters a final scrubber which wetted with an alkaline solution, for example, 0.25% chalk slurry. The gas is then discharged to the atmosphere after passing through a dry scrubber to remove entrained mositure. The alkaline solution flows downwards and mingles with the water from the water sprays. The gas washing plant is designed to treat the gases from a battery of nine boilers which constitute the first half of the station. Each of the first six of these boilers has maximum continuous rating of 312,000 and a peak rating of 330,000 lbs/hr. Part I reports on the general arrangment of the plant, the entry of gases into the main flue, specifications and layout, and the arrangement and construction of the two chimney towers. Part II continues with a description of the water services and pumps, and of the liming, apportioning, and aeration plants; it also includes a brief discussion of the calculation of the resistance to flow of gases. The plant converts the sulfites in the effluent to sulfates before the effluent is returned to the river. A brief statement of capital costs is appended.

20188

Squires, B. J.

FABRIC FILTER DUST COLLECTORS. THEIR USE IN THE VENTILATING, STEEL, NON-FERROUS METAL, CEMENT, POWER STATION AND CHEMICAL INDUSTRIES. Filtration Separation (Purley), 1967:228-239, May/June 1967. (Presented at the Meeting of the Filtration Society, Manchester, Jan. 17.)

Design aspects, industrial applications, and development of new fabrics for fabric filter dust collectors are reviewed. Fabric collectors are of three kinds: screen type filters, reverse jet or blow back filters at high filtering ratios, and tubular filters at normal filtering ratios; the latter are in most general usage, have undergone considerable recent development, and are described in detail. Theoretical criteria for fabric selections are noted. Some typical fabric filter installations are discussed. The use of a pre-coat filter aid in fabric filters to achieve very high cleaning efficiencies when filtering air and gas streams with low dust concentrations, such as the cleaning of atmospheric air for special ventilating systems, is one new application which has opened new fields for this equipment in the sewage, pharmaceutical, and steel industries. Particular attention is paid to the use of fabric filter dust collectors to clean high temperature gases and to applications in the cement, non-ferrous, smelting, and carbon black industries.

20223

Lemke, Kurt

PROCEDURE AND MECHANISM TO REDUCE THE PYRITE CONTENT OF COALS FOR THE PURPOSE OF REDUCING THE SULFUR OXIDE CONTENT OF EXHAUST GASES. (Verfahren und Vorrichtung zur Herabsetzung des Pyritgehaltes von Kohle zwecks Verringerung des Schwefeloxydgehaltes von Rauchgasen). (Bergwerksverband G. m. b. H., Essen, W. Germany) W. German Pat. 1,247,891. 3p., Aug. 24, 1967. 5 refs. (Appl. Dec. 12, 1964, 6 claims). Translated from German. Franklin Inst. Research Labs. Philadelphia, Pa., Science Info. Services, 7p., Aug. 10, 1969.

A process is described for the economic removal of pyrite from the finest fractions of coal or pyrite-enriched coal dust. It is based on the disintegration of coal into a light and essentially pyrite-free component and a heavy pyrite-enriched component, followed by the dry separation of the latter component according to its density. In the separation process, thin layers of coal dust are uniformly distributed across the entire width of a vibrator-sluice and guided over it. The sluice comprises a series of vibrating troughs which become successively more narrow and deep. In the course of its path over the troughs, the coal-pyrite mixture spreads out into particles having the same size but varying in weight according to their densities. The pyrite components are collected in end plates attached to the troughs; coal dust is passing over the plates. The collected pyrite is removed by an optically controlled throughput device which operates discontinuously, while the desulfurized coal components are again combined with the light components. The collected dust is used for coal-dust firing. The process has applications both for the treatment of coking dust and the desulfurization of fuel dust for coal firing.

20243

Oberhaeuser, Alfred and Wolfgang Benarndt

FIRING BOILERS WITH BLAST FURNACE GAS HAVING BEEN ROUGH-CLEANED IN THE DUST CATCHER AND CYCLONE. (Verbrennen von im Staubsack un Wirbler corgereinigtem Gichtgas im Kesselhause). Text in German. Stahl Eisen, 87(10):611-617, May 1967. (Presented at a meeting of the Arbeitsausschusses des Hochofenausschusses, Gross Ilsede, May 20, 1966.)

Since 1955, two boilers have been in operation in a power plant attached to a blast furnace in Ilsede which are operated with coal and cleaned waste gas from the blast furnace. A melting pot is ahead of the combustion chamber where one third of the coal and the ash stemming from the coal incineration are molten. Since the boilers were a great success, it was decided to use rough-cleaned waste gas from the blast furnace for the two new boilers which were being constructed. This had the advantage that the gas cleaning system of the plant did not have to be expanded; there was no heat loss; and the water consumption was reduced. The uncleaned waste gas contains 10 g dust/standard cu m. In addition to the gas, coal was fired. The dust separator installed in the path of the uncleaned gas to the boiler rough-cleaned the gas to a residual dust concentration of 1 to 2 g/standard cu m. Dry dust from the uncleaned gas settled in the feed pipe to the boiler. Thus this pipe had to be regularly serviced. Due to the large quantities of flue gas at the combustion of blast furnace gas (45% more than at coal), the boilers have a large combustion chamber. Erosion of the boiler pipes did occur, but could not be traced to the use of the blast furnace gas.

20262

Yoshimochi, Shuntaro and Kazumi Kamei

DAP-MN PROCESS FOR DESULFURIZATION OF FLUE GAS. Chem. Economy Eng. Rev., 1970:22-25, March 1970.

Research and development of an activated manganese oxide process (DAP-Mn) for removing sulfur dioxide from flue gases of large oil-fired power plants are described. Powdery activated manganese oxide is uniformly dispersed in the gas at the inlet of an absorber and carried along with the gas stream. The SO2 and SO3 in the flue gas react with the absorbent to form manganese sulfate. The reacted manganese sulfate and unreacted manganese oxide are collected after being separated from the gas stream by a multicyclone and electric precipitator. The activated manganese oxide is regenerated, and an ammonium sulfate solution is obtained, by treating the separated manganese sulfate solution with ammonia and air. Next, the regenerated manganese oxide is liberated from the ammonium sulfate solution and recycled to the circulation system. Other by-products that can be recovered are gypsum and phosphoammonium sulfate. Since flue gas is introduced to the absorber without pre-treatment, the method does not require boilers to be remodelled. Neither do absorbers or regenerators require special heat-or corrosion-resistant materials. The treated gas is kept above 110 C. In pilot-plant studies, the method removed 90% of the SO2 from flue gas with a SO2 concentration of 0.1 vol%.

20392

Higashi, M., S. Fukui, and K. Kamei

STUDY AND EXPERIENCE OF MHI ON THE LIME PROCESS FOR SO2 REMOVAL. Preprint, 12p., 1967. 4 refs. (Presented at the Third Limestone Symposium, Clearwater, Fla., Dec. 4-8, 1967.)

A pilot plant and an industrial plant using lime and slaked lime for the removal of sulfur dioxide are described. The pilot plant comprises a spray tower, a grid packed tower, a venturi scrubber, and an MHI (Mitsubishi Heavy Industries) cross flow absorber. The flue gas from the oil-fired boiler is conducted to the spray tower and cooled to about 55 C (130 F). It then passes the three kinds of absorbers arranged in a line. The gas contains 0.15% by volume SO2 and 0.0015/ SO3. Limestone slurry, chalk lime, and slaked lime were tested as absorbents. The reaction formula of the Lime Process is as follows: CaCO3 +SO2 +2H2O yields CaSO3.2H2O + CO2; Ca(OH)2 +SO2 +H2O yields CaSO3.2H20; and CaSO3.2H2O +1/2 O2 yields CaSO4.2H2O. The SO2 absorption ratio depends on the absorbent. All impurities in the by-product are from the raw material; hardly any are from the flue gas dust because the latter is almost completely retained in the spray tower. Venturi scrubbers have a large power consumption. Grid packed towers and MHI Cross flow absorbers are well suited for the process. The Grid Packed Tower is better for handling the slurry. The industrial plant using the lime process has a capacity of 63,000 cu m/h. The SO2 content of the gas is 0.3% by volume in the uncleaned gas; in the cleaned gas, it is 0.03%. Gypsum is recovered; carbide sludge is used as absorbent.

20425

Carls, E. L.

REVIEW OF BRITISH PROGRAM ON FLUIDIZED-BED COMBUSTION: REPORT OF U. S. TEAM VISIT TO ENGLAND FEBRUARY 17-28, 1969. Argonne Nation Lab., Ill., Chemical Engineering Div., 48p., Aug. 1969. 28 refs. CFSTI: ANL/ES-CEN -1000

A U. S. team visited British organizations that are concerned with the development of fluidized-bed combustion systems for fossil fuels, and obtained information on research facilities, experimental results, development programs in progress, and expected future work. Experimental efforts and conceptual design studies are aimed at the development of four types of fluidized-bed coal-combustion systems: an atmospheric-pressure utility-sized unit an industrial shell boiler, a pressurized fluidized-bed combustor, and a packaged water-tube boiler. In addition, application of the technique of fluidized-bed combustion to various fuel-oil burning systems is being studied. A variety of coals can be burned in a fluidized bed of coal ash at about 800 C with superficial gas velocities of 2-14 ft/sec without sintering or agglomeration, and carbon monoixde can be reduced to less than 0.1 vol %, which is equivalent to 0.3% carbon loss. Lower carbon losses were achieved in experiments at low gas velocities (2 ft/sec) and using coal crushed to minus 1/16 in.; the higher losses occurred in experiments at high gas velocities (14 ft/sec) and with coal crushed to minus 1/4 in. Recycling the elutriated material to the bed produced data to indicate that 95% overall efficiency can be achieved for an industrial shell-boiler design and greater than 99% for a conceptual utility-sized fluidized-bed combustor. Sulfur dioxide emission into the flue gas has been reduced by as much as 99% by the additon of 1 and 1/3 to 2 times the stoichiometric quantity of limestone along with the coal feed at a superficial gas velocity of 2 ft/sec. A preliminary cost comparrison between utility-sized units and projected to 1975 indicates capital charges of $132/kW for conventional pulverized-coal-feed units, compared with $120/kW for fluidized-bed combustion, or $137/kW to $125/kW if limestone injection were included. Decreased corrosion, erosion, and fouling of tubes would also be expected due to the lower temperature of combustion, which should result in less vaporization of alkali compounds. Problem area requiring resolution are coal distribtion, air distribution, and recycle of elutriated fines. (Author abstract modified)

20437

Burchsted, C. A. and A. B. Fuller

DESIGN, CONSTRUCTION, AND TESTING OF HIGH-EFFICIENCY AIR FILTRATION SYSTEMS FOR NUCLEAR APPLICATION. Oak Ridge National Lab., Tenn., Nuclear Safety Information Center, Contract W-7405-eng-26, 193p., Jan. 1970. 164 refs. CFSTI: ORNL NSIC-65

In order to review current practices and to define the problems in operating, maintaining, and controlling contamination release from very high-efficiency air-cleaning systems, visits were made to AEC production reactors, commercial power reactors, laboratories, radiochemical plants, reactor fuel manufacturers, clean rooms, equipment manufacturers, and one chemical-biological warfare installation. Operational considerations include filter change frequency, building supply filters, prefilters, operation to high pressure drop, and underrating, while environmental factors depend on the nature of the contaminants to be removed (radioactivity, toxicity, corrosivity) and on heat, moisture, and other conditions that can affect the performance or life of system components. Consideration must be given to damage of the filter system from shock, vibration, or fire; to design and arrangement of ducts and housings to alleviate these conditions; to the possibility of a power outage and means of switching to an alternate power system; and to methods of controlling the exhaust system during failure conditions. Factors that largely influence the cost of maintenance are the frequency and ease of replacing filters. In addition to the filters, important parts of the ventilating system are the fans, ducts, dampers, and instruments, which must be given design considerations. When space permits, round duct is preferred to rectangular duct because it is stronger and less likely to collapse under external pressure, is more economical of materials, provides more uniform air flow velocities, is easier to fabricate and erect, is easier to join and seal, and is usually cheaper. Other problem areas are ventilating system control and instrumentation, air sampling, and air intakes and stacks. Characteristics, construction, and limitations of the components are reviewed; types of filter systems, and gloved box filtration is described. Filters and adsorbers are tested, and the basic design and construction requirements are given for remotely maintained and reactor post-accident cleanup filtration systems.

20485

Shale, C. C., W. S. Bowie, J. H. Holden, and G. R. Strimbeck

FEASIBILITY OF ELECTRICAL PRECIPITATION AT HIGH TEMPERATURES AND PRESSURES. Bureau of Mines, Washington, D. C., Rept. of Investigations 6325, 20p., 1963. 15 refs.

The electrical characteristics of air in a 2-in. pipe-type electrostatic precipitator under dynamic conditions at 600-1500 F and 0-80 psig using a negative discharge electrode were studied for potential application to new processes for utilizing coal. These applications include removal of entrained fly ash from the products of combustion from coal-fired boilers to allow direct use of the hot pressurized gases to power a gas turbine, and removal of carbonaceous residue from synthesis gas made from coal in order to permit use of the senible heat in the gas. Results of this one-geometry study show that current-voltage relationships are a function of air pressure and temperature through about 1350 F over the full range of pressure. Corona starting voltage and sparkover voltage vary directly with pressure and inversely with temperature. At temperatures above 1350 F, use of precipitators may be limited to operations at pressures somewhat above atmospheric pressure. Theoretical derivations are presented that relate the effect of gas density on corona starting voltage and the effect of ion mobility on corona current. Deviation from the theory is noted at high current levels. Theoretical discussion is presented to explain the apparent electrical limitations for use of precipitators at high temperature, low gas density, and high corona currents, conditions at which calculated ionic velocities are extremely high. Experimental results are interpreted in terms of the theory presented. At 1500 F, thermal ionization does not appear to be a certain factor. (Author abstract modified)

20526

Fukuma, Shin-ichi and Kazumi Kamei

DRY-SYSTEM FLUE GAS DESULPHURIZATION PROCESS (DAP-MN PROCESS) FOR SO2 REMOVAL. Jap. Chem. Quart., 4(3):12-14, July 1968.

The dry-system flue gas desulfurization process employes activated manganese oxide as absorbent. Ammonium sulfate is obtained as by-product. A semicommercial plant capable of treating gases from a 55MW power plant equivalent to 150,000 cu m was constructed and first results on its operation were obtained. The gas which is being cleaned contains 0.1% by volume sulfur dioxide, 3.3% oxygen, 9.2% water, 11.9% carbon dioxide, 75.5% nitrogen, and 100 to 200 mg dust/cu m. It enters the desulfurization plant with a temperature between 135 and 150 C. Diffusion of activated manganese oxide powder in the gas and its transportation by the gas stream was satisfactory. A SO2 removal rate of 90% was obtained at a consumption of 150 to 250 g/cu m of absorbent. A constant absorption efficiency could be maintained over an extended period. The absorbent has good electric properties so that it is easily collected by an electrostatic precipitator. The total dust removal efficiency was 99.98%. The total pressure loss was below 100 mm water. The plant has three stations: the SO2 removal station; the absorbent regeneration station; and the by-product treatment station. In the first station, the absorbent reacts with SO2 and SO3 in the gas stream by forming manganese sulfate. This and unreacted active manganese oxide are collected in a multicyclone and electrostatic precipitator. At station 2, air (5 kg/sq cm) is blown into the manganese sulfate solution and ammonia water is added. At station 3, the ammonium sulfate solution is crystallized. Operating costs amount to 1.00 dollar per ton of fuel oil.

20539

Coutant, R. W., R. E. Barrett, and E. H. Lougher

SO2 PICKUP BY LIMESTONE AND DOLOMITE PARTICLES IN FLUE GAS. Preprint, American Society of Mechanical Engineers, New York, 9p., 1969. 7 refs. (Presented at the Winter Annual Meeting of the American Society for Mechanical Engineers, Los Angeles, Calif., Nov. 16-20, 1969, Paper 69-WA/APC-1.)

An investigation was made of the reaction between sulfur dioxide and limestone and dolomite particles in flue gas. Reaction data were generated by exposing the particles to localized boiler furnace conditions. Variables included in the study were residence time, temperature, particle size, SO2 concentration, and chemical state of the stone. A model is hypothesized for the SO2-particle reaction that is consistent with the experimental data. The hypothesis states that the initial reaction products are sulfites, and that as the particle temperature rises above 1400 F, SO2 is lost by the thermal decomposition of the sulfite. Concurrent with these steps, the sulfite can be oxidized and/or disproportionate to form sulfate. The net result is a maximum in sulfur pickup during the first second of exposure in the reactor. (Author abstract modified)

20550

Seidl, W.

DESULFURIZATION OF WASTE GASES, A CENTRAL PROBLEM OF AIR HYGIENE. (Entschwefelung von Abgasen, ein zentrales Problem der Lufthygiene). Text in German. Brennstoff-Waerme-Kraft, 20(3): 129-131, March 1968. (Report on two symposia of the VDI Commission on the Maintainance of Clean Air, June 2, 1967, Duesseldorf, and Oct. 24-26, 1967, Munich.)

Munich has temperature inversions on 285 days of the year; the city is almost always in a haze. To avoid large-scale air pollution episodes, city authorities determined the wind direction and speed, and measured the dust fall and sulfur dioxide concentration of the atmosphere. In order to reduce emissions, the city plans to extend the central heating system over the entire city (now 20% of the households are remotely heated). According to all available knowledge, SO2 removal from waste gases involves a good deal of money. None of the presently available methods are economical. Both Reinluft and Sulfacid processes adsorb SO2, O2, and H2O on coke. They differ, however, as far as desorption and regeneration is concerned. In the Reinluft process, SO2 is liberated thermally; in the Sulfacid process, it is scrubbed out. Sulfur can be also removed by binding it to alkaline dusts or aqueous dust suspensions which are added to the coal or injected into the combustion chamber. The Grillo desulfurization method can be used for the removal of sulfur dioxide, sulfur trioxide, hydrogen sulfide, and mercaptans. The Mitsubishi, Monsanto-Penelec processes and the method developed by the Bureau of Mines are briefly outlined. The latter process uses alkalized alumina to bind the SO2.

20552

Craig, T. L.

RECOVERY OF SULFUR DIOXIDE FROM STACK GASES: THE WELLMAN-LORD SO2 RECOVERY PROCESS. Preprint, Kentucky Univ., Lexington, 11p., 1970. (Presented at the Industrial Coal Conference Lexington, Ky., April 8, 1970.)

The Wellman-Lord sulfur dioxide recovery process, a wet regenerative system which recovers at least 90% of the SO2 from stack gas in excess of 97% of any SO3 and acid mists from the gas, and about 90% of the fly ash is described. This process, which uses either potassium or sodium, can be adapted to small industrial units, smelters, and fossil fuel-fired generating plants. The end products from the process can be gaseous or liquid sulfur dioxide which can be converted to sulfuric acid or elemental sulfur through the addition of commercially available equipment. The process has been demonstrated at the Maryland Clean Air Demonstration Plant, Baltimore, Md., and the first commercial unit is being installed. Capital and operating costs are reviewed and power cost increments of 0.40 mil per KWH for 2.5% sulfur coal and 0.44% for 5.0% sulfur coal are reported.

20563

Zubik, B.

INTRODUCTORY PROJECT UNDER CONTRACT WITH THE U. S. A. CONCERNING COOPERATION IN RESEARCH ON DESULFURIZATION OF COMBUSTION GASES. (Projekt wstepny umowny z USA o wspolpracy w zakresie badan nad odsiarzaniem spalin). Preprint, 9p., 1968 (?). Translated from Polish. Franklin Inst. Research Labs., Philadelphia, Pa. Science Info. Services, 12p.

The Fuels Department of the Power Metrology Research Organization 'Energopomiar' has the following divisions: Fuels Analysis, Fuels Technology, Research on Air Pollution, and Desulfurization of Combustion Gases. The research theme, 'research into the effect of introducing dolomite into boiler on the disposition of coals to form deposits on the heating surfaces', the objectives of the research, significance of the search, work schedule, time schedule, description of work, deadline, research in experimental and service conditions, the points the research will cover, the number of people and salaries involved, and costs of equipment to be acquired for the three year project are outlined. Specifically, the research will permit wider application of the method of desulfurization of the boiler combustion gases, based on introducing dolomite into the combustion chamber and determining the effect of intermittent or continuous introduction of dolomite into boilers which fire specified kinds of coal.

20663

Bienstock, D., J. H. Field, and H. E. Benson

SULFUR DIOXIDE IN ATMOSPHERIC POLLUTION, AND METHODS OF CONTROL. Nat'l Research Council Pub. 652, p. 54-62, 1959. 27 refs.

The undesirability of sulfur dioxide in the atmosphere has been recognized because of its highly irritating effect on the respiratory system, its adverse effect on plant life in concentrations as low as 0.3 ppm, and its attack on many metals, fabrics, and building materials. Based on a coal usage of 350,000,000 tons in 1955 and an average sulfur concentration of 1.9%, about 6,600,000 tons of sulfur or twice this amount of sulfur dioxide was emitted from this fuel source. Extensive industrial application of any process for removal of SO2 would result in the formation of tremendous quantities of sulfur products that would ultimately affect the market prices of sulfur in any of its forms; and the problem of storage and handling, marketability, and the selling price of the sulfur product will have considerable influence on the acceptability of a purification process. Several methods are available in the direct reduction of the sulfur content of coal prior to combustion, including mechanical cleaning of coal, partial gasification and carbonization to form a low-sulfur char, and complete gasification with a subsequent removal of the sulfur in the form of hydrogen sulfide. For removal of sulfur dioxide after combustion, consideration is directed toward the development of hot absorption processes.

20696

Miller, Leo A. and Jack D. Terrana

PROCESS FOR RECOVERING SULFUR DIOXIDE FROM GASES CONTAINING SAME. (Wellman-Lord, Inc., Lakeland, Fla.) U. S. Pat. 3,485,581. 5p., Dec. 23, 1969. 4 refs. (Appl. Nov. 15, 1966, 20 claims).

The concentration of sulfur dioxide in stack or furnace gases from coal-burning furnaces in electric power plants is often less than 1%. Conventional water-scrubbing processes are generally unsuitable for such small concentrations. In accordance with the present invention, SO2 concentrations as low as 0.3% can be recovered by scrubbing the gases with an alkali or alkaline earth metal sulfite, e.g., sodium or potassuim sulfite, to convert the latter to bisulfite; evaporating at least some of the water from the bisulfite solution at temperatures below the decomposition point of the bisulfite; and then heating the bisulfite to above the decomposition point to obtain SO2 and the mono-sulfite, which can be recycled. The process can be carried out in a packed tower or a plate tower containing bubble trays or sieve plates. The reaction zone temperature is between 100 and 230 F and the decomposition zone temperature, between 230 and 600 F. During the evaporation step, it is advantageous to replace the water being removed with an inert heat exhange material which is liquid under the evaporation zone conditions; the material is used in amounts sufficient to yield a slurry of the bisulfite in the material. (Author abstract modified)

20729

Squires, Arthur M.

PROCESS AND APPARATUS FOR DESULFURIZING FUELS. (Assignee not given.) U. S. Pat. 3,481,834. 21p., Dec. 2, 1969. 12 refs. (Appl. Aug. 21, 1968, 21 claims).

An improved method and apparatus are described for converting a sulfurous hydrocarbonaceous fuel, such as bituminous coal and residual oil, into fuel products low in sulfur; one of the products comprises of coke pellets. Fuel is charged to a lower zone of a fluidized bed, which comprises of the coke pellets, where the fuel is carbonized or cracked to form gaseous products and a fresh coke accrets upon the pellets. Gaseous products along with hydrogen fluidize a superposed, contiguous, upper zone of the fluidized bed; the upper zone comprises of a commingling of the coke pellets and a solid of smaller size containing a substance avid for sulfur from hydrogen sulfide, such as calcium oxide. The upper zone is fluidized at lower velocity than the lower zone, and the velocity of the lower zone is sufficient to prevent the smaller solid from penetrating deeply into the zone. Means are provided to ensure that, soon after a layer of fresh coke is formed on a given pellet, it goes to the upper zone, where the fresh coke is desulfurized through the cooperative action of the hydrogen and the smaller solid. Gaseous products are also desulfurized while passing through the upper zone. Fuel gas and coke, each low in sulfur, are withdrawn from the fluidized bed. (Author abstract)

20738

Rinaldi, L. and G. Sotgia

FURTHER STUDIES AND OBSERVATIONS OF THE BEHAVIOR OF SMOKE FROM LARGE POWER PLANTS, MAKING USE OF HYDRODYNAMIC MODELS. (Ulterior sviluppi di studi ed esperienze relativi al circuito dei fumi per centrali di grande potenza, mediante l'impiego di modelli fluidodinamici). Text in Italian. Termotecnica (Milan), 23(11): 544-552, Nov. 1969. 12 refs. (Presented at the Congress Nazionale ATI, 24th, Bari, Oct. 1969.)

A smoke behavior model of a particularly compact configuration was the subject of experiments aimed at obtaining a more rigid control over the flow of smoke in an electrostatic filter. After examining such problems as the structure of the circuit, its lateral position with respect to the stack, and the high degree of regularity required, criteria are formulated for the proper solution of the problem. Also examined critically is the degree of approximation of the parameters normally used to correlate the quality of flow distribution, observed from the model, with the purifying efficiency of the actual electrofilter. The problem of insufficient diffusion created by the strong divergence of the air ducts can be corrected, despite the difficulties, with a system that combines deflectors and screens, which should also permit a reduction of the total weight of the system.

20779

Berman, Paul A.

MOISTURE CONTENT AND COMBUSTION PRODUCT REMOVAL APPARATUS FOR EXHAUST GASES. (Westinghouse Electric Corp., Pittsburgh, Pa.) U. S. Pat. 3,473,298. 6p., Oct. 21, 1969. 7 refs. (Appl. Dec. 26, 1967, 4 claims).

An apparatus is described for recovering and utilizing water introduced into a steam injection power plant, and for removing moisture content and combustion products from exhaust gases before they are admitted to the atmosphere. This is accomplished by a recirculating water system in which the water initially is employed to directly contact and chill the exhaust gases in a spray chamber to effect removal of solid particle and water soluble contaminants. The water is then directed through a condenser for subsequently condensing the remaining vapor entrained in the gases, and to heat exchangers in an air mixing region in which ambient air is heated and added to the gases before they are admitted to the atmosphere, thereby providing a stack effluent of very low relative humidity. The temperature of the water is raised by its contact with the exhaust gases so that, when circulated through the heat exchangers, it functions to heat the ambient air with the consequent cooling of the water for return to the condenser and spray chamber.

20794

Squires, Arthur M.

KEEPING SULFUR OUT OF THE STACK. Chem. Eng. Deskbook, 77(9):181- 189, April 27, 1970. 44 refs.

New coal- or oil-fired power stations in the United States will commonly be on the order of 1000 to 2000 Mw by 1980 and the fuel consumption will range from 8000 to 16,000 tons/day of coal or 35,000 to 70,000 bbl/day of oil. Sophisticated equipment for removing sulfur from such large quantities of fuel in a unit adjacent to the power plant prior to final combustion may well be cheaper to build than devices for removing the sulfur oxides from enormous quantities of stack gases. Equipment is envisioned that would gasify solid fuel and treat the gas at elevated pressure, thereby handling only a small fraction of the molar flow and volume to be subsequently discharged from the stack following combustion. Such equipment might add no more than $10/kw capital cost because the power-generating machinery will cost less for a plant operating on sulfur-free fuel. Revenue from the sale of by-product sulfur would provide an offset against capital cost amounting to about $10/kw of capacity. The technical and economic feasibility of developing an intergrated fuel-chemicals-power complexes from existing coal gasification and fuel-oil desulfurization processes is examined.

20854

Dept. of Health, Education, and Welfare, Washington, D. C.

THE COST OF CLEAN AIR. Combustion, 41(10):25-32, April 1970. 10 refs.

The future costs of controlling sulfur oxides and particulate emissions from fuel combustion and selected industrial processes are reported. All estimates are based on the assumption that control will be achieved by applying the techniques already in use. There are three general approaches to controlling emissions from fuel combustion: fuel changes, stack gas cleaning, and improvements in combustion efficiency. Combustion source estimates are based on the assumption that all reduction in sulfur oxide emissions will be achieved through fuel substitution, and reduction in particulates through stack gas cleaning. Particulate emission control from industrial process sources is assumed to be achieved with electrostatic precipitators, cyclones, wet scrubbers, and fabric filters. Cost analysis for commercial fuel combustion is based on area fuel prices. Both investment and annual costs have been estimated: investment cost includes the price of control equipment and installation costs; annual cost is the sum of depreciation of the investment cost, capital-related costs, and operating and maintenance costs.

20914

Katz, B. and R. D. Oldenkamp

INTEGRATION OF MOLTEN CARBONATE PROCESS FOR CONTROL OF SULFUR OXIDE EMISSIONS INTO A POWER PLANT. Preprint, American Society of Mechanical Engineers, New York, 7p., 1969. 5 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, Los Angeles, Calif., Nov. 16-20, 1969, Paper 69-WA/APC-6.)

The molten carbonate process (MCP) is being developed to remove sulfur oxides from power plant stack gases. The process is a closed cycle system in which a molten eutectic mixture of sodium, lithium, and potassium carbonate is circulated to convert the sulfur oxides to sulfites and sulfates, which remain dissolved in excess carbonate. Conversions of 40% can be achieved without raising the melting point of the mixtures above 800 F. The salt mixture containing the sulfites and sulfates is subsequently reduced chemically to the sulfide form, then regenerated to the original carbonate form. The regeneration step releases hydrogen sulfide which can be converted to elemental sulfur or sulfuric acid. The process equipment is divided into two parts: equipment located outside the power plant stream, and equipment located in the flue gas stream. Optimum process component configuration for an 800 Mwe plant is discussed. Preliminary analyses indicate that a plant using carbon for the reduction step would cost $9.0 million. Annual operating costs would be 0.44 mils/kw-hr before the sale of the sulfur produced.

20995

McLaren, J. and D. F. Williams

COMBUSTION EFFICIENCY, SULPHUR RETENTION AND HEAT TRANSFER IN PILOT PLANT FLUIDIZED-BED COMBUSTORS. Combustion, 41(11):21-26, May 1970. 10 refs. (Also: Engineering (London), 27(5379), May 1969.)

As part of a research program into the combustion of coal in a fluidized bed for large-scale power generation, measurements of combustion efficiency and retention of sulfur by limestone were made in an 0.15-m diameter bed. Both reactions were taken virtually to completion during combustion of -10 BSS mesh coals at 800 C in a 0.6-m deep bed of ash fluidized at 0.6 m/s, when elutriated fines were recycled to the bed. In addition, experiments in an 0.3-m square combustor bed showed that bed-tube heat transfer co-efficients of 460 W/ sq m C (80 Btu/sq ft h F) can be achieved under these conditions, indicating that a large reduction in tubing costs should be possible. Further experiments in a 0.9-m sq cold bed on the effect of tube orientation on heat transfer indicate that it should be possible to pact the tubing required under these conditions into an 0.6-m deep bed. (Author abstract modified)

21005

Feldman, H. F., W. H. Simons, J. J. Gallagher, and D. Bienstock

KINETICS OF RECOVERY SULFUR FROM THE SPENT SEED IN A MAGNETOHYDRODYNAMIC POWER PLANT. Environ. Sci. Technol., 4(6):496-502, June 1970. 7 refs. (Presented at the American Chemical Society Division of Fuel Chemistry, 157th Meeting, Minneapolis, Minn., April 1969.)

The open-cycle magnetohydrodynamic (MHD) power plant offers a unique means of profitably recovering sulfur from coal combustion products. In such a plant, the combustion products are seeded with a potassium or cesium seed to make them electrically conductive. The seeding material, which has a great affinity for sulfur, must be recovered and recycled for the power plant to be economically feasible. Before recycling the slag-feed mixture to the generator, the sulfur in the mixture can be removed and converted to hydrogen sulfide with a hydrogen feed gas. The hydrogen sulfide can then be separated from the hydrogen by stripping with an ethanolamine solution and converted to elemental sulfur via the Claus oxidation process. Experimental and kinetic analyses of the conversion process are described, with the data obtained used to specify the design and operation conditions for a sulfur recovery reactor for a 1000-MWe MHD power station. The kinetic model also describes the regeneration of the absorbent in the alkalized alumina process for removing SO2 from power-plant stack gases.

21028

Goldschmidt, K.

PRACTICAL EXPERIENCES WITH WASTE GAS DESULFURIZATION PROCESSES IN INDUSTRY- CONCLUSIONS. (Praktische Erfahrungen im Bereich der Industrie- Schlussfolgerungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:133-139, 1970. 4 refs.

Practical experiences with desulfurization processes are discussed for combustion gases in plants. Experiments with additive suspensions (7:3 water to solid ratio) revealed that the best results were achieved with hydrated quicklime. However, only 20 to 30% of SO2 was removed by addition of 1.5 2.5 times the stoichiometrically required additive in the favorable temperature range of about 1500 C. The same amount of desulfurization was achieved by injection of dry calcium hydrate at 1150 C. Analysis of the sludge accumulating in the Bishoff-process revealed that it can be safely dumped without posing any danger to the groundwater. Tests with the Reinluft process using low-temperature soft coal coke, a dust concentration of 100g/cu m and of 2.9g/cu m, and an SO2 content of 2.6 and 2.9g/cu brought a 73% and 66% desulfurization. The Still process requires further modification to achieve any significant desulfurization. By wetting the catalyst a 70 to 80% desulfurization was achieved, but the catalyst consumption went up to 3 times the stoichiometrically required quantity.

21117

Klein, Heinrich

DUST COLLECTION BY THE TORNADO FLOW METHOD. OPERATION AND APPLICATION. (Drehstroemungs-Entstaubungsverfahren - Wirkungsweise und Einsatz). Text in German. Keram. Z., 20(8):479-484, 1968.

The development of the tornado-flow collector began in 1954. The first model consisted of a plexi-glass pipe with a diameter of 75 mm and a length of 1.50 m. A smaller inlet pipe protruded into the larger pipe at the bottom. Secondary air entered in the upper third of the pipe through a nozzle. The tornado flow consists of a potential flow and a rotational flow in the center. The two flows proceed in opposite directions. Development of the first model was followed by experiments in a power plant. The collector was installed in the bypass to the electrostatic precipitator. A collection efficiency of more than 90% was achieved with relatively fine dust particles. In 1963, two types of collectors of this kind were available: one with a capacity of 500 cu m/h and one with 2750 cu m/h. However, the energy requirement of these units was too high. Through alterations at the inlet and outlet, the collection efficiency was further increased to 98% while, at the same time, energy consumption was reduced. High capacity units for 7500 and 12,000 cu m/h became available. Presently, units with a capacity of 700,000 cu m/h are in operation. Such collectors are particularly suited for the separation of fine dusts and can thus be used in foundries, in the stone industry, food industry, wood-working industry, as well as collecting pulverized synthetics. The various possibilities of regulating the secondary air current which controls the collection efficiency makes this versatility possible.

21136

Hanby, V. I.

THE EFFECT OF GASEOUS OSCILLATIONS ON THE COMBUSTION RATE OF SOLID FUEL PARTICLES. Fuel Soc. J., Univ. of Sheffield, vol. 18:44-49, 1967. 11 refs.

Data from the literature and the results of an experimental investigation are presented to show that combustion rates of solid fuel particles can be increased by the effects of sound fields in two ways: by the creation of acoustic vortices with low amplitude pulsations, and by the aerodynamic scrubbing effect of high amplitude pulsations. Increases in combustion rates due to aerodynamic scrubbing are higher than those due to vortex formation. Under aerodynamic scrubbing conditions, the total combustion rate of the coal is increased more than the volatile combustion rate. Very high combustion intensities (10 to the sixth power Btu/cu ft/Hr) can be obtained for pulverized fuel by the utilization of the high amplitude sound field produced by pulsating combustion. The findings are especially relevant to the large furnaces used in the power-generating industry. (Author conclusions modified)

21200

Mueller-Wartenberg, Heinz

APPARATUS FOR CARRYING OUT A METHOD OF PURIFICATION FOR FLUE GASES. (Metallgesellschaft A. G., Frankfurt (W. Germany)) U. S. Pat. 3,475,133. 14p., Oct. 28, 1969. 6 refs. (Appl. Dec. 30, 1965, 9 claims).

An apparatus is proposed for a multi-stage method of purifying flue gases which contain sulfur compounds, particularly the flue gases of oil or coal-fired boilers. After the gases have been previously treated in coolers and scrubbers and had the dust removed from them in mechanical or electrical dust precipitators, they are subjected to a wet catalysis with coal or carbon as the catalyst in order to remove the sulfur-containing compounds, particularly sulfur dioxide. The cooler and/or scrubber, and, if employed, the dust precipitator are arranged vertically one above the other with catalyst reaction beds in a tower-like common housing of prefabricated plates forming a closed gas shaft. The gas shaft is divided up vertically into a series of flues by a series of superimposed catalytic reaction beds and run-off trays which form barrier walls. The reaction beds are staggered vertically in a staircase-like manner so that they are shifted with increasing length into the oncoming flow of gas. The lateral offset provides an upwardly decreasing flow area on the inlet side of the beds and an upward increasing cross-sectional flow area on the outlet side of the beds. The lower part of the gas shaft forms an acid or fluid collecting container.

21232

Hunter, J. B.

PLATINUM CATALYSTS FOR THE CONTROL OF AIR POLLUTION. A TAIL GAS REDUCTION SYSTEM FOR NITRIC ACID PLANTS. Platinum Metals Rev., vol. 9-12:2-6, 1965-1968. 1 ref.

Effective reduction of nitrogen oxides, hydrocarbons, and organic vapor is obtained by the use of platinum catalysts supported by a ceramic honeycomb. Use of the ceramic honeycomb support overcomes the two principle objections to platinum as a catalyst in pelletized form, pressure drops across pelleted beds, and loss of fines. Other important advantages for honeycomb catalysts are the elimination of hot spots, more uniform gas distribution, greater structural strength, and no channelling. From the standpoint of system design, the rigid structure also provides greater process flexibility. Horizontal as well as vertical reactors may be used. In nuclear power installations, intense radiation causes the decomposition of water into a hydrogen/oxygen mixture. Platinum honeycomb catalysts are effective as hydrogen/oxygen recombiners.

21234

Diehl, Erle K.

REDUCTION OF EMISSION OF OXIDES OF NITROGEN--PRESENT AND FUTURE PROSPECTS. Preprint, Public Health Service, Washington, D. C., Div. of Air Pollution, 4p., 1966. (Presented at the Conference on Air Pollution, National, Washington, D. C., Dec. 12-14, 1966, Paper B-11.)

Oxides of nitrogen are among the gaseous components emitted from heat and power generation equipment and should not be ignored in the overall evaluation of air pollution. Any process which produces high temperatures in the presence of atmospheric nitrogen and oxygen will yield oxides of nitrogen as a combustion product. Nitrogen oxide (NO) and nitrogen dioxide are of significance in photochemical smog. Emissions of NO from combustion stacks can range from less than 100 ppm to over 1500 ppm. A method of operation known as staged combustion results in a reduction of NO of up to 40%. Current methods under investigation for the removal of other contaminants may also have a marked effect on oxides of nitrogen. Acceptable ground level concentrations of nitrogen oxides must be established before application of known chemistry to the problem will proceed.

21238

Pearson, J. L., G. Nonhebel, and P. H. N. Uhlander

FLUE GAS CLEANING AT FULHAM POWER STATION. Fuel Econ., vol. 12:108-109, Dec. 1936.

A washing cycle for flue gases which completely eliminates scaling problems is described as applied to a power station. The process depends upon a property of calcium sulfite and sulfate, their ability to very readily form stable supersaturated solutions, with the corollary that precipitation takes place very slowly from these solutions. A grid system was employed to provide maximum absorbing surface for the liquid. A flue-gas scrubber may be subjected to rapidly varying loads, so the acid and alkali constituents of the liquid must be monitered constantly. This can easily be accomplished with a pH recorder.

21268

Spaite, Paul W. and Robert P. Hangebrauck

HEW SPELLS OUT AIR-QUALITY GOALS. Elec. World, 173(20):25-27, May 18, 1970.

About half of the air pollution from industrial and commercial activities is produced by the burning of coal, oil, and natural gas. The emissions originate in power plants, industrial boilers, and small installations used for commercial and residential heating. Power production, which accounts for 70% of the total sulfur oxides emissions from combustion, is the most important source. Power plants also account from 30% to 40% of all nitrogen oxides emissions. Particulate emissions appear to be less critical than SOx or NOx, but this may be misleading because particles less than 1 micron in size are not accounted for. Conventional electrostatic precipitators can reduce the emissions slightly, but the number of fine particles will increase by a factor of four between 1970 and 2000. Control of SOx emissions by flue-gas cleaning should soon be practicable. The 'throwaway' processes, which involve reacting SOx with limestone, to be collected as calcium-sulfur in precipitators or wet scrubbers, are most likely to find application. Reliable methods must be developed for controlling NOx emissions from boilers. Electrostatic precipitators could control much of the fly ash, but many of those operating today function inefficiently because they were designed for less stringent requirements or have lost efficiency. There is a critical need for improved systems and techniques for controlling submicron particles.

21275

Oda, Kenichi and Yoshimi Ishihara

METHOD FOR REMOVING SULFUR DIOIXDE FROM FLUE GASES OF A COMBUSTION FURNACE. (Electric Power Industry, Tokyo (Japan), Central Research Inst.) U. S. Pat. 3,481,289. 4p., Dec. 2, 1969. 2 refs. (Appl. May 13, 1968, 5 claims).

A method for removing sulfur dioxide from the flue gases of a fuel oil or coal fired furnace is described. An hydroxide, converted from an oxide in discharge calcined limestone or dolomite, is injected into the furnace. A newly prepared powder of limestone or dolomite is also injected. Although the calcined product discharged from the furnace contains sulfates, the main component is calcium oxide. When water is added to convert the oxide to hydroxide, the hydroxide formed has a high reactivity and removes SO2 very effectively. The reactivity of the hydroxide can be improved by using an iron salt solution as the hydration water. Previous proposals to remove SO2 from flue gases by injecting pulverized limestone or dolomite powder into a furnace have the advantage of being inexpensive and simple, but the disadvantage that the rate of SO2 removal is low.

21313

Bieber, K. H.

SUCCESSFUL OPERATION OF WET SOOT BLOWERS. (Betriebliche Bewaehrung von Wasserrussblaesern). Text in German. Mitt. Ver. Grosskesselbesitzer, 50(2):83-88, April 1970. 1 ref.

Wet soot blowers were installed in the boilers of a power plant to prevent heavy soiling on the flue gas side. Condensate from the turbines was used as cleaning agent. The blowers were installed in two rows in the lower section of the first flue. The effective diameter of the front and rear blowers was adjusted to 8 m; that of the side blowers, to 5 m. The water consumption per blower was 0.25 cu m. At first the blowers were used three times a day and later, only once a day. The heating surfaces within the reach of the blowers in the first flue could be kept 90% clean. Steam blowers were installed between the first and second flue. A single application of them per day sufficed to prevent fly ash incrustations. Test of the duct material revealed no adverse effects caused by the blowers. One blowing operation from turning on to turning off the blower lasted 20 min. The pure blowing time was 12 min. The blowers failed several times because of deformation by falling incrustations. After operation of the blowers in the first flue, heavy soiling occurred in the second flue so that ten steam blowers had to be installed.

21324

Kato, Yujiro

PLANS AND OPERATIONAL EXAMPLES ON FILTER TYPE DUST COLLECTOR SYSTEM AT VARIOUS INDUSTRIES (VI). THE ROLE OF BAG FILTERS IN THE METALWORKING INDUSTRY. (Gyoshubetsu ni miru rokashiki shujin sochi no keikaku to unten jisshi rei (VI). Kinzoku kogyo ni okeru baggu firuta). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(10):663-668, Oct. 15, 1968.

The operational conditions of bag filters used for emission control in the metalworking industry are illustrated by examples. In the zinc refining industry, bag filters are used at various points. The baghouse for the independent electric power plant which is provided to allow the exhausted material to cool down is one example. Another is the baghouse for controlling emissions from a smelting furnace exhaust. The applications of bag filters to the aluminum industry is illustrated by the baghouse used to control emissions from an alumina coveying process. In a powdered lead manufacturing plant, a complete dust collector has to be provided since the lead dust is extremely toxic and cannot be allowed to escape into the atmosphere. Complete hooding is also necessary. In the nonferrous metal working industry, emissions are commonly worth recovering. High efficient dust collectors are adequate for this purpose. In the iron and steel industry, the collected material from the exhaust is generally of little value, but dust collectors are necessary for air pollution control. Their use is typified by baghouses equipped for controlling emissions from electric-arc steelmaking furnaces and from electric furnaces for ferro-alloy manufacture. In the metal processing industry, bag filters are also used for controlling emissions from various processes. An example is the baghouse equipped for controlling emissions from the finishing process of iron casting.

21381

Squires, Arthur M.

CLEAN POWER FROM COAL, AT A PROFIT'0. Preprint, American Association for the Advancement of Science, Washington, D. C., 36p., 1969. 48 refs. (Presented at the Symposium of the American Association for the Advancement of Science, Power Generation and Environmental Change, Boston, Mass., Dec. 28, 1969.)

Coal technology is discussed to support the conclusion that methods capable of suppressing sulfur dioxide emissions from coal and at the same time reducing power costs are feasible, if sufficient funds are made available for their development. The history of coal-firing techniques is reviewed, with emphasis on pulverized fuel firing now in general use at large power stations. Rising standards of air quality are putting this method under severe economic pressures; its simple, one-step combustion places the coal's sulfur promptly into a form difficult to collect and recover. New techniques of coal combustion, in which pollution control is a first consideration, hold greater hope for the future than makeshift schemes for control at the final point of pulverized fuel firing. These techniques, particularly the basic fluidized-bed process and subsequent modifications of it, are discussed in detail. For the future, attention is being directed to the concept of the 'Coalplex,' a producing complex in which chemical extraction and power generation would be integrated; one such scheme provides for the conversion of the volatile matter in coal to synthetic pipeline gas or liquid fuel. The fixed carbon would be desulfurized to produce a low-sulfur coke suitable to fluidized-bed techniques.

21504

Zentgraf, K. M.

INDUSTRIAL-SCALE TESTS OF THE DESULFURIZATION OF SMOKE. (Prove su scala industriale per la desolforazione dei fumi). Text in Italian. Riv. Combust., 22(7-8):402-408, 1968. (Presented at the Conference on Le grandi centrali termoelettriche e nucleari ed i problemi dell'inquinamento atmosferico, Rome, Italy, April 4, 1968.)

Results are presented of comparative, semi-industrial scale tests of four methods of desulfurizing heating plant smoke. The methods are additives and the Reinluft, Still, and Bischoff processes. For the Reinluft process, which uses adsorbents, efforts are under way to find the most suitable of easily available materials, e.g., lignite coke instead of the original peat coke. The other three processes use powdered limestone, lime, and calcium hydrate for which substitues are also being investigated. There is also difficulty in handling the process tail products; for instance, disposal of the residue to obtain saleable by-products is a question that cannot always be easily decided. The special advantages attending each process are described, and costs are given for the Reinluft and Still processes. (Author abstract modified)

21506

Johnstone, H. F.

METALLIC IONS AS CATALYSTS FOR THE REMOVAL OF SULFUR DIOIXDE FROM BOILER FURNACE GASES. Ind. Eng. Chem., vol. 23:559-561, May 1931 7 refs. (Presented at the American Chemical Society Meeting, Division of Industrial and Engineering Chemistry 81st., Indianapolis, Ind., March 30-April 3, 1931.)

A method to remove sulfur dioxide from stack gases is described. The method involves increasing the solubility of SO2 in water, or aqueous solution, to such an extent that the amount of water required for the removal of SO2 from gases containing very small concentrations of this constituent would be reduced to a point where the process would be economically and mechanically feasible. The capacity of water for absorbing SO2 may be increased by introducing a catalyst to hasten the reaction between the dissolved gas and oxygen. An experimental procedure using metals and metal sulfates as catalysts is described, and test results are given.

21594

Chass, Robert L. and Ralph E. George

CONTAMINANT EMISSIONS FROM THE COMBUSTION OF FUELS. J. Air Pollution Control Assoc., 10(1):34-43, Feb. 1969. 5 refs. (Presented at the Air Pollution Control Assoc., Annu. Meet. 52nd, Los Angeles, Calif., June 21-26, 1959.)

The emissions of air contaminants from the burning of fuel oil present a serious air pollution problem in Los Angeles County. Most industrial plants and steam-electric generating power plants are equipped to burn both fuel oil and natural gas. If all these plants were to burn fuel oil with an average sulfur content of 1.5%, the resultant emissions would be 320 tons of sulfur dioxide, 185 tons of nitrogen oxides, and 30 tons of combustion contaminants per day. If natural gas was used exclusively, such emissions would be reduced to 0.1 ton/day of SO2, 120 tons of nitrogen oxides, and 3 tons of combustion contaminants. Although oil refineries burn only a third as much fuel oil as power plants, their combined fuel usage is greater than that of power plants. An investigation and stack testing program was initiated for other industrial sources. All the stacks were tested for combustion contaminants, aldehydes, nitrogen oxides, SO2, sulfur trioxide, hydrocarbons, carbon monoxide, carbon dioxide, and oxygen. Results are presented in tabular form. The direct control of power plant emission has been approached from three aspects: treatment of the fuel, boiler modification, and treatment of the effluent. The substitution of natural gas for fuel oil would eliminate particulate matter and sulfur compounds, and greatly reduce the nitrogen oxides from the stack effluent.

21643

Ohtsuka, Tadao, Osamu Shimoda, Teruo Yatabe, Kuinio Sugino, and Kenji Tanaka

INJECTION TEST OF AMMONIA GAS AND DOLOMITE POWDER INTO OIL-FIRED BOILER. Nippon Kokan Giho (Tokyo), vol. 5:17-24, 1962. 7 refs. Translated from Japanese. Belov and Associates, Denver, Colo., 26p., April 16, 1970.

Tests were conducted to develop a means of counteracting the accumulation of NH4HSO4, a combustion by-product with a low melting point, in the air-heater of oil-fired boilers. The compoun is formed when ammonia gas is injected into the combustion gas to neutralize sulfuric acid produced by the combustion of sulfur bearing fuels. The ammonia injection temperature zone is an important factor in this method. Accordingly, ammonia injection was applied to a boiler in a thermal power plant for one month, using an injection rate of 0.6/0.07 wt % of fuel oil fired, and an injection temperature zone of -180 C in the flue gas. A satisfactory reduction of NH4HSO4 accumulation was obtained under these operating conditions. Experiments were also conducted on the effectiveness of dolomite powder injection in reducing corrosion caused by sulfuric acid in the combustion gas; using an air-cooled corrosion probe, reduction of corrosion was observed to begin at an injection level of 0.3 wt % of fuel ooil fired. Injection of fly ash also showed some potential as a low-cost method of reducing corrosion. (Author summary modified)

21720

Stone and Webster Engineering Corp., Boston, Mass.

SULFUR DIOXIDE SCRUBBERS. STONE AND WEBSTER IONICS PROCESS. (FINAL REPORT). NAPCA Contract CPA 22-69-80, 22p., Jan. 1970. 34 refs. CFSTI: PB 189377

A study was conducted to determine the most economical scrubber for the removal of sulfur dioxide from flue gas produced by a coal burning power plant. The scrubber would be specifically designed to operate as part of a system using the Stone and Webster/Ionics SO2 removal process. This process includes an SO2 scrubber where SO2 is absorbed in a sodium hydroxide solution to form a sodium sulfite/bisulfite solution which is sent to a neutralization stage. An attempt was made to select equipment which would achieve 90% SO2 removal. Since no supporting data were supplied, at least two actual contact stages are provided in all cases. The efficiency of SO2 absorption and the amount of oxidation that occurs in the six scrubbers tested are discussed. An economic comparison of various scrubbers is also included. The Johnson packed tower appears to be the most economical scrubber; all other units are considerably more expensive than the Johnson Unit. Until manufacturers of venturi, cyclonic, and floating ball scrubbers can produce very large single units, their evaluated cost makes the use of such units in the Stone and Webster/Ionics process impractical.

21819

Ludwig, John H.

AIR POLLUTION CONTROL TECHNOLOGY: RESEARCH AND DEVELOPMENT ON NEW AND IMPROVED SYSTEMS. Law Contemp. Probl., Spring 1968:217-226. 15 refs.

In the area of pollution control from stationary sources, major research and development is now concentrated on the control of sulfur oxides. In the future there will be expanded programs for other pollutants, especially nitrogen oxides. Major emphasis on control of emissions from motor vehicles is now focused on reduction of carbon monoxide and hydrocarbons. Future efforts will focus on control of nitrogen oxides and particulates and on unconventional vehicles with low pollution potential, such as electric-powered and steam-powered cars. Instruments and techniques are now available for measuring many pollutants, especially inorganic gases, but there is a need for automated, smaller-sized instruments both for stationary sampling stations and for airborne sampling of the atmosphere. There is also a need for remote-type monitors capable of measuring stack emissions at a distance. In the area of meteorology, a number of urban diffusion models and an air pollution potential forecast program are now operational; improved models and quantitative forecasting methods are under development. (Author conclusion)

21886

Brocke, W.

SOOT SEPARATION AT OIL FIRED FURNACES. (Russabscheidung bei Oelfeuerungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:279-285, 1970. 19 refs.

Fuel oil consumption in the Federal Republic of Germany increased from 17.9 million tons in 1965 to 21.4 million tons in 1968, with the power plants alone accounting for about 25% of this amount. A heavy fuel oil-fired boiler emits between 0.23 to 8 kg dust/ton of oil. During normal operation the dust contains 90 to 95% of combustible matter, during soot blowing 75 to 93%. Dust concentrations between 15 and 400 mg/cu Nm could be measured in the waste gas during normal operation, and between 1000 and 10,000 mg/cu Nm during soot blowing. The gas contained 12% by weight sulfuric acid. Of the dust particles, 80% had diameters of less than 20 microns, with 20 to 30% having diameters less than 5 microns. Dust emission measurements taken at four oil-fired boilers (16 to 20 tons/h) revealed that centrifugal separators reduced the emissions from between 46 to 55 mg/cu Nm to between 24 and 40 mg/cu Nm during normal operation, and from 1050 to 1870 mg/cu Nm to between 104 and 174 mg/cu Nm during soot blowing. Better results can be achieved with electrostatic precipitators, but they are considerably more expensive.

21893

Lowicki, Norbert, Gernot Hanig, and Klaus Husmann

THE - WASTE GAS - SULFUR - PROCESS. REPORT ON THE DEVELOPMENT OF A PROCESS FOR THE REMOVAL OF SULFUR FROM FLUE GASES. Grillo-Werke A. G., Duisburg-Hamborn (West Germany), Oct. 1969. Translated from German. Belov and Associates, Denver, Colo., 68p., March 30, 1970.

The difficulty of the removal of sulfur from waste gases varies according to the origin of the waste gas. Waste gases of steam boiler plants precipitate rather uniformly with respect to quantity temperature, and composition. On the other hand, sinter waste gases contain additional metal oxide smoke which can complicate the process of sulfur removal. Thus, the process selected should have no sensitivity to disturbing gas components and should have versatility with respect to the absorption of any of the sulfur compounds coming under consideration. A desulfurization process was developed which is an absorption process with thermal regeneration of the charge absorbent. The process principle selected is based on the reaction of oxide compounds between a basic and an amphoteric heavy metal component. The presence of a compound Mg6MnO8 has been proven using X-ray structure investigation; the presence of a compound Mg3MnO5 is also probable. In this combustion, the basic component is used as the actual absorbent and the heavy metal component as the oxygen donor. This has the effect of increasing the total activity of the mixture. For the same reason, the absorption of hydrogen sulfide from waste gas is also made possible. In the thermal regeneration of the charge mass, both components protect each other reciprocally against deactivation. Economic aspects were a primary consideration in the selection of the desired components for the absorption mass. This eliminated elements like Cr, V, Mo, and Zn. Though Ca and Mg were practical, Fe and Mn were selected because of the rapid formation and stability of the oxide compounds between them as well as the inactivity during absorption. All chemical and process-technological predictions made on the basis of laboratory experiments were confirm. For oil-fired steam boiler plants, flue gas desulfurization plants ready for practical use can be set up and operated. Capital outlays and operational costs are given for an oil-fired 300 MW power plant, in addition to total annual operational costs. A particular advantage of this process is that the charge mass can be regenerated by various desulfurization systems at a central location.

22001

Bacon, Raymond Foss

RECOVERY OF SULPHUR FROM ROASTER GASES. (Assignee Not Given.) Brit. Pan. 7, 1932. (Appl. Jan. 12, 1931, 3 claims).

This invention provides a means of enriching with sulfur dioxide the gases evolved from the roasting of pyrite ores or other sulfide minerals, thereby making the recovery of elemental sulfur from roaster gases economically feasible. The method comprises preheating air entering the roasting retort to 300-600 C, as well as equipping the retort with longitudinal baffle plates which carry finely divided sulfur material up the side of the retort and shower it down through the heated air. Preheating permits the oxidation reaction to begin immediately upon the entrance of the air into the retort. The sulfur-enriched gases leaving the retort are then passed to a reduction furnace supplied with suitable reducing material, e.g., coke or coal. Hot gases produced in the reduction step are withdrawn through any suitable heat-exchange apparatus and utilized for preheating the air.

22012

Benner, Raymond C. and Alfred Paul Thompson

METHOD OF RECOVERING SULPHUR. (General Chemical Co., New York) U. S. Pat. 1,771,480. 7p., July 29, 1930. (Appl. March 2, 1926, 24 claims).

A method for reducing sulfur dioxide to elemental sulfur is described. The SO2-containing gas is admitted at the top of a reduction chamber, and bituminous coal is continuously fed in through a feed mechanism. Sufficient air is introduced to oxidize some of the combustible matter to maintain the required 700-800 C temperature. As the coal enters, a sudden partial coking occurs, liberating large amounts of hydrocarbons and free hydrogen. As the SO2 enters, it encounters a strongly reducing atmosphere consisting of solid carbon particles, hydrocarbons, and free hydrogen, and its reduction begins. The gaseous products pass downward through the hot coke bed where tar and soot are driven off and the reduction reaction continues. After the gaseous products are removed from the coke bed, SO2 gas is added to the mixture to provide sufficient reducible gas to react with the reducing gases, hydrogen sulfide and carbon monoxide, which are present. The resulting mixture is passed over a bauxite catalyst. The temperature of the catalyst should be above that at which the elemental sulfur formed will condense and be retained, and below that where interaction of sulfur and water vapor occurs to form SO2 and H2S.

22014

Tyrer, Daniel

IMPROVEMENTS IN THE PRODUCTION OF SULPHUR FROM SULPHUR DIOXIDE. (Imperial Chemicals Industries, Ltd., London (England)) Brit. Pat. 357,178. 5p., Sept. 16, 1931. (Appl. June 16, 1930, 7 claims).

This invention relates to the production of sulfur from sulfur dioxide by the reduction of the latter at 600-800 C with semi-coke that is carbonized from raw coal as the result of direct contact between the coal and the sulfurous gases. Contamination of the gases by tar vapors arising during distillation of coal is avoided by passing the gases and vapors through the lower layer of semi-coke, heated to about 1000 C, where the vapors decompose to leave the gases in a suitable condition for the recovery of sulfur. In one form of the invention, the process is carried out in a pair of vertical retorts. Initially, both are partly charged with semi-coke and the charge completed by feeding raw coal over the semi-coke. Both retorts are then raised to red heat by an air blast, after which a mixture of sulfur dioxide and air is fed to the base of the one retort. The air is supplied in an amount sufficient to cause the heat evolved in the combustion of the semi-coke to compensate for the heat absorbed in reduction. The resulting gases are passed upwardly through the layer of coal in one retort and downwardly through the layer of coal in the second retort, then through the lower layer of semi-coke in the second retort.

22051

Davidson, W. C.

ENGLAND IS CUTTING ITS AIR POLLUTION. Elec. World, 174(4):42-44, Aug. 15, 1970.

Sulfur dioxide monitoring and other experiments in power-plant diffusion techniques are reported, nearly 20 years following the great London smog of 1952. As a result of a public inquiry by the National Society for Clean Air, the British government passed the 1956 Clean Air Act, and a further act in 1968 has lead to a modernization of industrial heating equipment and great improvements in the domestic fire. While emission of SO2 from power stations has increased by 35% over the past ten years, ground-level concentrations have fallen by as much as 30%. In Britain, the answer to the sulfur problem is seen exclusively in high-level dispersion through very tall chimneys. These stacks are of multiflue design, one flue per unit. This maintains the full efflux velocity with just one unit in operation, allows maintenance without shutting down the whole station, and permits access to the aircraft warning lights at any time via internal elevators. Monitoring has shown that the modern power station makes no contribution to ground-level SO2 pollution at times when there is high pollution from other sources (i.e., during fogs and temperature inversions) because the hot plume penetrates into the moving air above. Maximum pollution from the power station occurs at times of strong surface winds. At a station in Eggborough, use is made of a nearby 1250-ft TV mast to study plume dispersion at really close quarters; telemetered instrumentation is sending 6-million readings a year for computer processing. Sulfur trioxide is also produced, but trace amounts are beneficial from an engineering point of view, for the SO3 provides a conductive layer on the fly ash which significantly improves precipitator efficiency. The use of coal or oil to provide fuel for the power station is also discussed.

22057

PROMISE SEEN IN STACK-GAS SO2 REMOVAL. Oil Gas J., 64(18):53, May 2, 1966.

The progress of three companies in removing sulfur dioxide from stack gases is reported. The Babcock and Wilcox process involves injecting dolomite, or other alkaline additives, into the hot stack gases and then filtering them through fiber-glass filter bags. Efficiency of sulfur recovery has not been disclosed, but it is believed that this process will prove satisfactory when used on large power plants. The Monsanto process will remove SO2 from flue gas by oxidizing it to trioxide, and then condensing the latter to sulfuric acid. Based on a 3% weight fuel, the cleaned gases from the precipitator would contain 2000 ppm SO2 and 20 ppm SO3. In passing through the catalyst bed, the SO2 concentration is reduced to 200 ppm and that of SO3 increased to 2300 ppm. In a rotary air preheater, the 600 F temperature drop causes the formation of sulfuric acid mist which is collected and removed as sulfuric acid. About 90% of the stack gas sulfur was recovered at a concentration of 70% sulfuric acid in pilot plant tests. Combustion Engineering's process has not been tested outside the laboratory. However, these tests were encouraging in that the sulfur content of the gases was greatly reduced. It is believed that this process will be confined to large industrial sources due to the expense of the treating equipment. The hydrodesulfurization of residual fuel oils is briefly discussed.

22070

Wallsom, H. E.

THE ELIMINATION OF DUST AND SULPHUR FROM BOILER FLUE GASES. J. Inst. Fuel (London), vol. 6:226-233, April 1933. 3 refs.

British power stations are now required to reduce as far as reasonably practicable chimney emission of flue dust and sulfur fumes. General methods available for minimizing the flue dust problem are pretreatment of coal; suitable chimney design; and dust collection by electrical precipitators, centrifugal collectors, or washing. Methods available for the removal of sulfur compounds from flue gas are as follows: washing by water; washing with a solution or suspension of alkaline material; the reduction of sulfur compounds to elemental sulfur; the oxidation of sulfur compounds, for example, to sulfuric acid; the interaction of the sulfur compouds with an alkaline gas, and the recovery of the compound formed by water washing. A comparison of the efficiencies of these methods shows that wet systems are highly efficient in abating dust and fume emissions. For fine dusts, either electric precipitaton or washing is recommended; for larger dust particles, centrifugal collectors would probably be satisfactory. The deciding factor in the choice of electric or wet processes is the facility with which large quantities of water can be obtained and disposed of. When wet washing it used, corrosion-resistant lead linings are recommended for washing chambers and stacks.

22071

Douglas, Jack

INSTRUMENTS AND CONTROLS FOR INDUSTRIAL POWER PLANTS. Nat. Eng., 73(7):10-12, July 1969. (Presented at the Industrial Fuel Oil Conference, 7th, of the Illinois State Association, National Association of Power Engineers, Chicago, Ill., May 21, 1969.)

Large power plants have long known the importance of carefully designed combustion control systems. The need to reduce air pollution and operational costs now requires similar control planning on the part of small boiler installations. Automatic draft controls should be provided for pressurized boilers, in which pressure at the boiler exit tends to vary with burner firing rates. Such controls make it possible to maintain relatively constant boiler output pressure or temperature, thus insuring proper air/fuel ratios for efficient combustion. Equally important is the boiler's utilization of the heat generated. All steps of steam generation should be checked by a flue temperature gauge which shows the degree to which the boiler has absorbed the heat generated. Another measure of boiler efficiency is the amount of oxygen in the flue gas. Reliable paramagnetic instruments are available for these measurements. Finally, master lead-lag sequence controllers, which treat all boilers as one in supplying the load demand, should be provided in multiple boiler installations. These devices increase the life of packaged boilers and eliminate the need for constant human monitoring.

22103

Chedd, Graham

FERTILIZER FROM FLUE GASES? New Scientist, 36(569):281-283, Nov. 2, 1967.

A modification of the American alkalized alumina process for recovering elemental sulfur from flue gases may make it possible for British power plants to reduce atmospheric contamination by sulfur dioxide and at the same time reduce the dependency of British fertilizer and sulfuric acid manufacturers on sulfur imports. In the original process, flue gases are passed upward through a rain of alkylized alumina spheres. The absorbent containing the sulfur dioxide is then passed to a regenerator where it is heated and treated with producer gas to recover sulfur as hydrogen sulfide. After oxidation of one-third of the hydrogen sulfide to sulfur dioxide, the two gas streams are mixed and passed over a bauxite catalyst. Elemental sulfur is produced. In the British modification, the rain of alkylized alumina particles is replaced by a fluidized bed of high-porosity sodium aluminate. Sulfur dioxide from the flue gases diffuses into the pores of the alumina and reacts to form a mixture of sodium sulfate, sodium sulfite, and aluminum oxide. The mixture is passed to a solids regenerator where it reacts with hydrogen to form hydrogen sulfide. The rest of the process is similar to the original. The process could reduce the sulfur import bill by 1.2 million pounds per year and stabilize sulfur processes.

22110

Reed, L. E.

REMOVAL OF SULPHUR OXIDES FROM FLUE GAS: THE REINLUFT PILOT PLANT. Warren Spring Lab., Stevenage, U. K., Atmospheric Pollution Div., LR 15(AP), 27p., Sept. 1965. 4 refs.

Pilot plant tests on the adsorption and desorption of sulfur oxides in the Reinluft process are discussed. This process can be operated continuously at an efficiency of over 90% and the sulfur oxides can be recovered as sulfur dioxide at a concentration of about 3%. The process is not, however, sufficiently well developed to be applied to a large scale process. It was necessary to replace carbon due to attrition losses in the elevator and plant and chemical losses in the desorption process. An initial loss of 16% of the charge in the first 40 hours and subsequent losses of 4%/day were recorded in one test; since carbon replacement is likely to be a major item, this indicates that these costs could be prohibitive. The uptake of SO_2 by the carbon was only 6-7% whereas bench scale tests indicated that 12% uptake would be easily obtained. At the design throughput of 450 cu m/h, the pressure drop through the absorber bed was approximately 7.6 cm H_2O. Most of the mechanical breakdowns were caused by corrosion; these were most severe when it was necessary to operate for short periods, each of which produced a corrosive acid condensate. If the process is used on a coal-fired plant it will be essential to clean the gases before and after treatment.

22127

Ergun, Sabri and Ernest H. Bean

MAGNETIC SEPARATION OF PYRITE FROM COALS. Bureau of Mines, Washington, D. C., Rept. of Investigation 7181, 25p., Sept. 1968. 30 refs.

Previous studies of magnetic separation of pyrite from coals are reviewed critically. Magnetic susceptibilities of United States coals of differing rank are measured. The effects of crushing, magnetic mixing, drying, weathering, and heat treatment on the enhancement of the magnetism of pyrite are analyzed. The importance of size distribution of pyrite in the coal and the necessity of crushing to liberate the pyrite is discussed. The inherent susceptibilities of the carbonaceous, mineral-free portions of coals and of relatively pure pyrite isolated from coals do not permit efficient separation of pyrite from coal. Friction forces encountered in crushing sedimentary pyrite embedded in coal do not increase its susceptibility. Subsequent weathering or heat treatment below 400 C leads to the formation of iron sulfate and hence increases the effective paramagnetism of pyrite. Ferromagnetic compounds of iron are not formed in significant quantities at temperatures below 400 C. The degree of liberation and apparent susceptibility of pyrite are the most important parameters in its separation. Effective beneficiation of coals can be achieved by magnetic separation. A sufficient increase in the susceptibility can be achieved by converting less than 0.1% of pyrite into ferromagnetic compounds of iron. Such conversions occur only at temperatures greater than 500 C. An investigation of the dielectric properties of coals and pyrite in the frequency range 0.1 to 60 Mhz indicates that the imaginary dielectric constant of the pyrite is about 100 times larger than that of coal. Exploratory experiments indicate that pyrite can be selectively heated to temperatures above 500 C without appreciable rise in the temperature of coal. It appears that dielectric heating of coals in the Ghz frequency range is the most feasible method of enhancing the paramagnetism of pyrite. (Author abstract modified)

22160

Kitani, Tsuruo

IMPROVEMENTS OF HEAT EQUIPMENT AND METHODS OF SMOKE AND SOOTS IN THERMAL POWER PLANTS. (Karyokuhatsudensho netsusetsubi no kaisen to baien taisaku). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(7):8-15, July 30, 1970.

A report is given of how heat equipment and air pollution control equipment has been improved and how it is being managed at a thermal power plant located in Chiba Prefecture, Japan (Ichihara Works). In Chiba Prefecture, abatement regulations are applied when air quality falls below specific standards. The plant installed low-sulfur residual oil tanks in April 1966. The low-sulfur containing oil us used when the regulations are applied. In June 1966, the plant added ammonia injectors to the exhaust ducts to control air pollution and also to prevent problems associated with sulfurous acid emissions. In December 1966, the plant equipped a pilot plant for removal and recovery of sulfur dioxide. The tests and research conducted there were successful. Special attention was given to the production of ammonium sulfate by scrubbing sulfur dioxide with ammonia and the collection of the sulfate by a collecting system called 'jet-collector'. The ammonium sulfate dissolves in a solvent held by the jet collector. The ammonium-sulfate solution in then concentrated and crystallized. Over 95% recovery of sulfur dioxide is achieved; 98% recovery is possible by bringing the plant to 40-35 C. This plant is described in detail. Other equipment for air pollution control at the plant are a high central smokestack and an oil-blender, which is used to reduce the percentage of sulfur contained in the fuel oil. The plant is also directing its effort toward heat recovery, and improvements have been made at several points. The thermal efficiency of a plant power is generally 32-40% with a large percentage of heat lost in the coolant. Recovery and utilization of heat from the coolant increases heat efficiency and eliminates the public nuisance caused by discharging hot water.

22175

Boux, Joseph F.

CANADIANS PIONEER NEW FLY ASH PROCESSING SYSTEM. Minerals Process., 10(3):16-19, March 1969.

Reclamation of huge quantities of fly as produced by power generating stations can be of great importance in the economics of these coal-fired plants. By total utilization of the fly ash, the plant described produces a number of commercial products: a fine pozzolanic fraction useful as a cementitious material in concrete; an iron concentrate which could be pelletized for blast furnace feed; carbon which could be used as fines or pelletized for fuel; and a large volume of beneficiated fines which would be processed into lightweight aggregates. Plant design is based on upgrading the fly ash by separating its various components which are uniform in specification. All fly ash, both from mechanical and electrostic precipitators, is separated into two main fractions: a fine fraction with 90% passing mesh and a coarse fraction of plus 325 mesh. Since the coarse material retains most of the iron values, it is passed through a magnetic separator that produces the iron fine concentrate and a coarse sinter fuel. The fine fraction can also be sintered if necessary to meet product requirements. Provision has also been made to screen the coarse fraction when there is an excess of carbon particles. Products of these processes are much more uniform than raw fly ash and each can be more readily converted into commercial products.

22279

Levy, Stanley Isaac

TREATMENT OF IRON PYRITES FOR RECOVERY OF SULPHUR AND FORMATION OF IRON OXIDE. (Assignee Not Given.) Brit. Pat. 403,961. 9p., Jan. 1, 1934. (Appl. June 30, 1932, 7 claims).

The recovery of sulfur and iron oxides from pyrites by an oxidizing and a reducing step is described. Oxidation is accomplished by causing finely divided pyrites to fall continuously at a uniform rate through a combustion chamber. Air is introduced continuously in a quantity insufficient for the complete combustion of the mineral. A reaction between the pyrite and the oxygen of the air occurs to form iron oxide, sulfur dioxide, and free sulfur. The chamber is insulated and the rate of entry of mineral and air are so adjusted that the exit gases are at a temperature of approximately 1000 C. Gases then pass through a reducing zone, and are contacted with finely divided coal, coke, or charcoal. Most of the sulfur dioxide is reduced to elemental sulfur with the information of carbon dioxide. The gases passing from the reducing zone contain, as sulfur vapor, most of the sulfur originally introduced in the form of pyrites. They are passed through suitable dust chambers, condensers, and scrubbers so that the elemental sulfur may be removed. It is recommended that the combustion and reduction chambers be contained in one structural unit.

22291

Mitsubishi Heavy Industries, Ltd., Hiroshima (Japan), Hiroshima Experiment Station

GAS ABSORPTION CAPACITY OF VENTURI SCRUBBER. (Ventsuri skurraba ni yoro gusu kyushu). Mitsubishi Heavy Industry, Ltd., Tech. Rev., 3(3):1-7, 1966. 11 refs. Translated from Japanese. Belov and Associates, Denver, Colo., 26p., May 23, 1970.

The effect of a venturi scrubber on the gaseous effluent of a power plant is described. Special characteristics of the scrubber, and the nature of flow of the scrubbing liquid are discussed. The scrubbing liquid consists in part of limestone, manganese oxide, and water. Previous experiments on the capacity of the venturi scrubber as a gas absorbent are limited by small scale installations. The experiment described is conducted on a scaled-up version of a fuel-oil boiler. The effect of operating variables on each factor of gas absorbing capacity is analyzed. Graphic illustrations of changes in one parameter in terms of another one are included.

22327

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. SUMMARY REPORT. Contract PH 86-67-128, Rept. AI-68-104, 165p., Feb. 1968. 8 refs. CFSTI: PB 179908

A molten carbonate process to remove sulfur dioxide from power plant stack gases is described wherein the sulfur oxides are absorbed in a molten mixture of lithium, sodium, and potassium carbonates. The resulting carbonate-sulfite mixture is then regenerated chemically. Developmental effort is in four major areas: process chemistry, including absorption, reduction, and regeneration; corrosion studies, to determine suitable construction materials; contactor development, specifically scrubbers; and component development. Work has been initiated on pilot plant and component test loop design. (Author summary modified)

22401

Edouard, L.

THE MEASUREMENT OF DUST CONCENTRATIONS IN THE CHIMNEY INPUT GASES AT THE THERMAL POWER STATION OF CREIL(OISE). (La Measure des concentrations en poussieres des gaz a l'entree des cheminees de la centrale thermique de Creil(Oise)). Genie Civil, p. 270-276, 1961 (?). Translated from French. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 29p., Oct. 31, 1969.

Coal-burning electric power stations are equipped with dust removing devices to clean their effluent gases. The devices are usually of the electrostatic, scrubbing, or cyclone variety. A pollution control system at a particular power plant in France is described. A stack sampling procedure is presented to measure the quantity of dust remaining in the system after the control devices. Test equipment includes a probe, a filtering device, a gas-flow meter, and a vacuum pump. Various types of filters are described, noting the advantages and drawbacks of each. Determination of flow rate from inside and outside the flue is discussed.

22441

STACK-GAS SULFUR MAY BE BOON TO FERTILIZERS. Chem. Eng. News, 45(40):72, 74, Sept. 18, 1967.

The possibilities for sulfur recovered from power plant stack gases to become a major raw material source for the fertilizer industry, now facing short supplies and high prices of sulfur, are briefly discussed. The type and quality of the recovery product whether as ammonium sulfate, sulfuric acid, sulfur dioxide, or elemental sulfur will indicate its importance for the industry. High costs of shipping very dilute gases may require location of the fertilizer plant next to the power plant.

22500

Conrad, Guenter

PROBLEMS IN THE CONSTRUCTION OF HIGH SMOKESTACKS IN THE GERMAN DEMOCRATIC REPUBLIC. (Probleme beim Bau hoher Schornsteine in der DDR). Text in German. Energietechnik, 17(12):550-551, Dec. 1967.

Problems connected with the designing and construction of high industrial smokestacks as they emerged during the planning of the construction of a 300 m high steel-concrete smokestack for the Boehlen II power plant in East Berlin are discussed. This height was necessary if the ground sulfur dioxide concentration was not to increase above its present levels with the projected draught capacity of 7.5 million cu m flue gas per hour. Decisive for the steadiness of so high a structure was the correct determination of the wind stress factor which was calculated from data about wind currents, velocity, and frequency supplied by the Meteorological Service and from wind tunnel experiments. A concrete lining reinforced by locally available materials is foreseen for the flue gas duct proper to be built inside the static smokestack column. The empty space between the flue and the column is designed to reduce the heat stress on the structure and will permit easy inspection of the lining. While present technology permits a daily erection of 2.5 m of the structure with the protective lining being constructed with the help of a separate scaffolding, specially constructed sliding shells foreseen for this construction are expected to increase the daily construction of both the column and the lining to 4 to 6 m.

22501

Quitter, Volker and Bruno Degner

CYCLONE SEPARATOR FOR POWER PLANTS. (Zyklonabscheider fuer Energieanlagen). Text in German. Energietechnik, 17(12):536-538, Dec. 1967. 7 refs.

Cyclone dust arresters in power plants can process at most 100,000 cu m/h air; their dust separation efficiency decreases with decreasing particle size. If particle size, composition, and dust concentration of the air to be purified are known, then the effectiveness of dust separation and the residual dust pollution in the purified air can be calculated for all types of cyclone dust arresters manufactured on the basis of their past performance. Theoretical calculations are still not quite accurate In small industries, mechanical dust arresters are cheaper than electrostatic precipitators. The servicing of dust arresters involves the control of dust removal which should be continuous. Discontinuous emtying can lead to clogging in which case the stream of air passes through the equipment without being purified. Pressure must be watched: loss of pressure indicates clogging. Cyclone cylinders must be inspected for tightness: air infiltration through cracks in the wall reduces dust separation efficiency. Defective heat insulation can lead to corrosion or to caking of dust. The dust residue in purified air must be checked regularly the manufacturer's lubrication schedule must be followed, and finally in the case of multiple cyclones equal distribution of the air flow to individual cyclones must be checked regularly.

22505

Quack, Rudolf

DUST AND GAS EMISSIONS FROM THERMAL POWER STATIONS. (Die staub-und gasfoermigen Emissionen von Waermekraftwerken). Text in German. Brennstoff-Waerme-Kraft, 10(18):479-486, Oct. 1966. 19 refs.

The pollution generating components of the various fuels used by thermal power stations are analyzed and the pollution control methods available are reviewed. The dust content in flue gases from solid fuel furnaces is from 0.5 to 15 g/cu m. In small and medium large grate firings which generate dust with 50% of the particles larger than 10 micron mechanical centrifugal separators are the rule. Siliconized glass fiber filters are too costly for large steam generators but can be used in smaller installations. Large installations, to comply with the pollution control requirements set by the West German laws, are compelled to use electrostatic precipitators. Liquid fuel furnaces use mostly heavy heating oil which with an ash content of only 0.01 to 0.05% emit dust only through soot formation by the flame or from additives. Crushing and transport installations for solid fuels and for combustion residues can also emit dust. Of the gases emitted from solid fuels, sulfur dioxide from the oxidation of sulfides can be removed by dry adsorption on semicoke or the coal can be converted to gas and the gas desulfurized. Desulfurization of heavy fuel oils is accomplished through hydration which converts the sulfur to hydrogen sulfide. Desulfurization should be done centrally in large plants rather than by each power station separately. While the production of electricity in West Germany increased fourfold from 1950 to 1963, the dust pollution from power stations has been reduced by one third. Further reduction of the pollution level with present means would be financially prohibitive.

22552

Farr, J. W. and G. R. Monroe

PROPOSED INDUSTRY STANDARD FOR ELECTRIC POWER SUPPLIES USED WITH INDUSTRIAL GAS PROCESSING PRECIPITATORS. Preprint, Inst. of Electrical and Electronics Engineers, New York, 7p., 1956. 8 refs. (Presented at the American Institute of Electrical Engineers, Winter General Meeting, New York, Jan. 31, 1956, Paper 56-337.)

Standards are provided for electric power supply equipment used with industrial gas processing precipitators; the equipment generally will consist of a rectifier transformer, one or more filament transformers when needed, rectifying components, and control or current-limiting components. Definitions and terminology are given. Temperature and altitude service conditions are listed, as well as the terms in which rating shall be expressed The standard frequency and limits of temperature rise are included. Control equipment, transformer losses and exciting current, dielectric tests, test procedures, terminal markings, and nameplates are also mentioned.

22559

National Academy of Sciences, Washington, D. C., Federal Construction Council

IMPACT OF AIR POLLUTION REGULATIONS ON FUEL SELECTION FOR FEDERAL FACILITIES. Contract CST490, TR-57, 52p., 1970.

Results of a report to determine the extent to which current and anticipated air pollution regulations will restrict the types of fuel which Federal agencies will be allowed to burn in steam power and central heating plants are described. Procedures to be used in taking account of such restrictions in economic analyses to determine the type of fuel to burn are included. Three fossil fuels coal, oil, and gas- are evaluated regionally from the standpoint of availability, quality, and price. Types of emissions which are considered include smoke, particulates, nitrogen oxides, and sulfur oxides. Control equipment to remove sulfur oxides is not to be considered by Federal facilities unless there is no other alternative. Existing and anticipated air pollution control regulations for the nation are presented.

22560

Aurielle, R.

THE ELECTRICAL DE-DUSTING EXPERIMENTAL INSTALLATION OF THE CHATOU TEST AND RESEARCH CENTER. (L'installation experimentale de depoussierage electrique du centre de recherches et d'essais de Chatou). Bull. Centre Rech. Essais, Chatou (France), no. 18:63-72, 1966. 10 refs. Translated from French. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 15p., Oct. 29, 1969.

A prototype electrostatic precipitator for thermal power-station smoke has two electric fields in a series, each constituting an electro-filter with collecting and emitting electrodes. The collecting electrodes are plates connected to the positive pole; the emitting electrodes are wires connected to the negative pole. The d-c potential difference between the plates and wires ionizes the air around the wires by corona effect. During their passage between the electrodes, dust particles are electrically charged by the ions or by molecular diffusion according to their size. The charged particles are attracted by the oppositely charged collecting surfaces on which they come to rest. The electrodes are hammered or vibrated to free them of deposited dust, which falls by gravity into receiving hoppers. The efficiency of the filter, defined as the ratio of the weight of captured dust to the weight of dust entering the device, depends on the electrode hammering and on the erosion of the deposited dust layer. To determine efficiency, soot deposits are weighed and, to find the mass of unretained soot, the concentration is measured at a point upstream of the electro-filter. Preliminary tests of the filters are in progress at a special experimental center.

22615

Ward, W. J., III and C. K. Neulander

IMMOBILIZED LIQUID MEMBRANES FOR SULFUR DIOXIDE SEPARATION. (FINAL REPORT). General Electric Co., Schenectady, N. Y., Research and Development Center, NAPCA Contract PH-86-68-76, G. E. Rept. S-70-1053, 12p., March 1970. 37 refs. CFSTI: PB 191769

An immobilized liquid membrane was developed which at 100 C has a sulfur dioxide flux of 0.0032 cc/(sec),(Sq cm),(cm Hg pressure differential) at standard temperature and pressure) and a sulfur dioxide/carbon dioxide separation factor of 14. The membrane operated for one month at 100 C with no change in permeation properties. The membrane could not withstand a pressure difference of 1 atm across it. However, a technique was recently developed which may make it possible to overcome this limitation. The low SO2/CO2 separation factor makes the use of this membrane for removing SO2 from power plant stack gases economically unattractive. An economically attractive system has been conceived for treatment of higher SO2 concentration, and lower total flow stack gases, such as those emitted from many ore-smelting processes.

22661

Chekanov, G. S., I. A. Kizim, I. K. Reshidov, and I. N. Il'inskaya

CHARACTERISTICS OF ELECTRICAL REMOVAL OF ASH FROM FLUE GASES WHEN BURNING EKIBASTUZ COAL. (Osobennosti elektricheskoy ochistki dymovykh gazov ot zoly ekibastuzskogo uglya). Text in Russian. Elek. Sta., vol. 6:6-9, 1970. 2 refs.

Results from pilot operation of a PGD-3-38-PBTs electrofilter are reported. It was found that efficiency and reliability of the filter depends significantly on the specific electrical resistance and adhesive quality of the ash, composition and temperature of the flue gas, and the concentration and dispersion of the ash in the gas. The need for methods to determine the electophysical and physicochemical properties of ash from power-plant fuels is stressed. The need for full-scale testing to establish proper height and spacing of the corona electrodes required to prevent reverse corona in such filters was also demonstrated.

22671

Pradel, Y.

IMPROVEMENTS IN THE DUST-REMOVING DEVICES OF THE PORCHEVILLE POWER STATION RESULTS OBTAINED. (Perfectionnements apportes aux depoussiereurs de la centrale de Porcheville resultats obtenus). Rev. Gen. Thermique (Paris), March 1963, 16p. Translated from French. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 34p., Nov. 3, 1969.

The Porcheville Power Station consists of four 125 MW units, each equipped with a combined mechanical and electrostatic dust-removing device. These units were placed in operation between March 1956 and April 1957. The original dust-removing devices proved to be insufficient, the efficiencies falling to less than 70% under maximum load conditions. A series of modifications were undertaken to improve the efficiency of the devices. These included increasing the time during which the gases remain in the electrostatic precipitator, changing the location of the mechanical collector, cleaning and adjusting the electrodes, improving the soot flow and air-tightness of the chambers, and modifying the electric supply. These changes resulted in a 20 point increase in efficiency; this corresponds to an approximate 5 to 1 reduction in the amount of dust discharged into the atmosphere. The present objective is to maintain the dust-removing devices in good operating condition by keeping the electrodes clean, accomplishing an optimum adjustment of the rectifier voltage, limiting the number of emitting electrode breakages, and obtaining a perfect adjustment of all mechanical parts of the devices. After the completion of the work in progress, efficiencies of 96% for maximum boiler load and 98% for normal production conditions will be possible. Of particular interest was the benefit obtained by relocating the multicyclones downstream from the electrostatic precipitators. Prior to the relocation the precipitators received only small particles which formed a tightly clinging coating on the electrodes which resisted cleaning agitation. When the relocation of the multicyclones permitted the precipitator to receive larger particles, these interrupted the surface of the coating on the electrodes sufficiently to greatly improve cleaning efficiencies.

22702

Sincay, Alexandre Calley St. Paul de

MANUFACTURE OF SULFUR. Societe Anonyme des Mines et Fonderies de Zinc de la Vieille Montange, Paris (France) Brit. Pat. 2993. 9p., May 19, 1866. (Appl. Nov. 21, 1865, claims not given).

The production of sulfur by the reduction of sulfurous acid and the means of rendering the sulfurous acid completely innocuous is described. Gases produced by the reduction of sulfuretted ores, and which should contain as much sulfurous acid as possible, are collected on their exit from the furnace, or in case the roasting takes place in open air, at the moment of their formation, and conveyed through a pipe of metal, stoneware, refractory bricks, or other material by means of a natural or artificial draft to a brick reducing furnace whose size is in proportion to the quantity of gas to be reduced. The interior of the brickwork is hollow and contains muffles or crucibles of metal, stoneware, refractory, or other materials. Coke, coal, peat, other charcoals, or material rich in carbon is introduced into the muffs or crucibles, which extend outside the furnace, and are heated by an ordinary or gas furnace. Under the action of a brisk red heat, the reducing agent decomposes the sulfurous acid and disengages sulfur, which is passed off with the other gases by means of a natural or artificial draft into condensing receptacles consisting of sheet-iron reservoirs having wire gauze compartments or other equipment suitable for separating the sulfur from the gases. The more or less pure sulfur collected is refined by conventional methods.

22740

Spengler, Guenter and Georg Michalczyk

SULFUR OXIDES IN WASTE GASES AND IN THE ATMOSPHERE. AN AIR POLLUTION PROBLEM. (Die Schwefeloxyde in Rauchgasen und in der Atmosphaere. Ein Problem der Luftreinhaltung) Text in German. Duesseldorf, Vereins Deutscher Ingenieure Verlag, 1964, 152p. 53 refs.

A general review is presented of the presence of sulfur dioxide and sulfur trioxide in the atmosphere, and the problems relating to this fact. About 80 of the 152 pages are devoted to a description of processes for SO2 removal from waste gases. Among the topics discussed are the sulfur content of fuels, dilution methods, physiological and corrosive effects, and methods and equipment for measuring and evaluating SO2 content. Among the removal processes discussed are the various types of organic and inorganic absorption media, adsorption processes, metals and metallic oxides, reactions with various gases, and the desulfurization of solid, liquid, and gaseous fuels.

22756

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART IV. CONTRACTOR DEVELOPMENT. Contract PH 86-67-128, AI-70-8, PR-2, 56p., 1968. 10 refs. CFSTI: PB 191960

Gas-liquid chemical absorption reactors were studied for application to a molten carbonate sulfur-removal process. Exploratory experiments showed that absorption of sulfur dioxide in a eutectic mixture of lithium, potassium, and sodium carbonates is very rapid. A continuous wetted-wall absorber demonstrated that the rate of sulfur dioxide absorption in carbonate is limited by mass transfer in the gas phase. To demonstrate that high efficiency of sulfur dioxide absorption is possible in a continuous reactor, a 2 in. column fitted with baffles was assembled. The baffles created the necessary turbulence to allow virtually complete sulfur dioxide removal. The transfer unit height (HTU) of the baffled column was 7 in. compared with approximately 70 in. required for a sulfur dioxide HTU in an unbaffled column. The absorption of nitric oxide was also tested with the baffle column. Experimental results indicated that nitric oxide reacts slowly in the carbonate melt. The transfer unit height for nitric oxide ranged from 38 to 111 in. Nitric oxide did not significantly alter the absorption of sulfur dioxide. Sulfur dioxide was absorbed in a spray of molten carbonate under three conditions: low-velocity gas flow (less than 2 ft/sec), low-velocity gas flow with fly ash added to the sprayed carbonate, and high-velocity gas flow (approximately 25 ft/sec). In the low-velocity tests, the percent of sulfur dioxide removed from simulated flue gas varied with the fineness of the spray and with the amount of carbonate in excess of the stoichiometric requirement. Mist-like sprays allowed 99.9+% sulfur dioxide removal. (Author abstract modified)

22792

Tomb, Thomas F. and Lewis D. Raymond

EVALUATION OF THE PENETRATION CHARACTERISTICS OF A HORIZONTAL PLATE ELUTRIATOR AND OF A 10MM NYLON CYCLONE ELUTRIATOR. Bureau of Mines, Washington, D. C., Rept. of Investigations 7367, 9p., March 1970. 13 refs. CFSTI: PB 190651

The penetration characteristics of a horizontal plate elutriator and of a 10-mm nylon cyclone were evaluated. The test aerosols were polydisperse coal-dust particles with diameters from less than 0.3 to 15 micrometers. Particle densities were 1.3 to 1.4 gr per cu cm. Equivalent Stokes diameter were measured by Coulter counter analytical techniques. The penetration characteristics of the horizontal plate elutriator closely approximate the sampling efficiency curve defining the respirable fraction of the dust cloud recommended and adopted by the Johannesburg Pneumoconiosis Conference in 1959. Penetration characteristics of the 10-mm cyclone were evaluated at flow rates of 1.4, 1.5, 2.0, 2.5, and 2.8 liters of air per min. The data indicate that the penetration curve obtained at 2.0 liters per min most closely approximates the sample efficiency curve for respirable dust recommended at a meeting sponsored by the U. S. Atomic Energy Commission in 1961. (Author abstract modified)

22806

Hughes, Dorsey F.

POTOMAC ELECTRIC POWER COMPANY STATEMENT. Preprint, 32p., 1967. (Presented at the Interstate Air Pollution Abatement Conference National Capital Metropolitan Area, Washington, D. C., 1967.)

The Potomac Electric Power Company operates three in-city steam-electric generation stations in the Washington metropolitan area and two stations 30 miles distant from the District of Columbia. In addition, another station is under construction on the extreme fringe of the Washington area. For its in-city plants, the company is making every effort to procure low-sulfur coal. This approach, however, is not considered feasible for the larger suburban stations. To obtain adequate, assured quantities of one percent sulfur coal for the latter would necessitate contracting with mine operators for the opening of new mines. Rather than commit itself to the purchase of high-cost, low-sulfur coals for periods as long as 20 or 30 years, the company prefers to postpone such commitments in the belief that commercially feasible stack-control devices will be available within a period of five years. These are expected to reduce stack emissions of sulfur dioxide substantially below what is achievable simply by the burning of one percent sulfur coal. Data is presented to counter a current report indicating that emissions from the suburban stations contribute to the buildup of atmospheric sulfur dioxide concentrations in the city of Washington.

22809

Shibler, B. K. and M. W. Hovey

PROCESSES FOR RECOVERING SULFUR FROM SECONDARY SOURCE MATERIALS. Bureau of Mines Information Circ., no. 8076, 62p., 1962. 561 refs.

A bibliography of articles relating to sulfur recovery methods is presented. In addition to general information on sulfur, the material on processing methods is arranged under the six principal sources of secondary sulfur, as follows: volcanic sulfur, including all elemental sulfur deposits not adaptable to the Frasch mining process; hydrogen sulfide as found in sour natural gases, petroleum refinery products, and coke-oven gases; sulfur dioxide from the roasting and smelting of metal sulfide ores and from power plant waste gases; pyrite and pyrrhotite obtained by mining mineral deposits or produced as by-products from the concentration of sulfide ore; gypsum and anhydrite occurring as deposits of calcium sulfate; and industrial wastes containing sulfates, sulfites, and sulfuric acid, such as those produced in the steel, paper, and petroleum industries. Hydrogen sulfide can be utilized for acid making and for conversion to elemental sulfur. Recovery processes for sulfur dioxide include the manganese dioxide and the ammonium sulfate methods. Sulfur from petroleum refining acid wastes can be obtained by regeneration, compounding, or coking processes. (Author summary modified)

22861

Bartok, W., A. R. Crawford, A. R. Cunningham, H. J. Hall, E. H. Manny, and A. Skopp

SYSTEMS STUDY OF NITROGEN OXIDE CONTROL METHODS FOR STATIONARY SOURCES. FINAL REPORT. VOLUME II. Esso Research and Engineerin Co., Linden, N. J., Government Research Lab., NAPCA Contract PH-22-68-55, E.R.E.C. Rept. GR-2-NOS-69, 601p., Nov. 20, 1969. 747 refs. CFSTI: PB 192789

The findings and conclusions of a systems study of nitrogen oxide control methods for stationary sources are reported. The study characterized the nature and magnitude of the stationary NOx emission problem for the U. S., assessed existing and potential control technology on the basis of nation-wide cost-effectiveness, and recommended a comprehensive 5-year R&D program on stationary NOx control. Stationary sources account for 55-60% of the total NOx emissions in the U. S. between now and the year 2000, estimated on an uncontrolled basis. Fossil fuel sources will be responsible for over 90% of stationary NOx emissions. Non-combustion sources, e.g., nitric acid plants are important only from the standpoint of local health hazards and aesthetic problems. Available technology is not well developed for controlling stationary NOx emissions. Of the potential control techniques assessed, combustion modifications show the most promise because of their relative simplicity and projected low cost. Requirements for the development of a mathematical model predicting the fate of NOx in combustion processes were defined and a first-generating model was formulated in this study. Combustion flue gas treatment techniques may have to be developed to control NOx emissions from large, coal fired electric power plants, since suitable combustion modification techniques may not be feasible for this category of emission sources. Such treatment may also control sulfur oxide and particulate emissions. Technology is available for controlling emissions from plants manufacturing or using nitric acid, but case-by-case economic and engineering evaluations are required to select the most appropriate techniques. The 5-year R&D plan recommendations are based on the cost-effectiveness of developing stationary NOx emission control technology and on the knowledge gaps identified in this systems study. These recommendations consist of basic and applied program items, which involve combustion processes, flue gas treatment processes, non-combustion processes, and the required support studies. The program items are grouped in priority blocks, based on their potential impact on stationary NOx emission levels in the U. S. Complete details of the NOx systems study are presented in Volume II of this report.

22868

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART VI. SMALL PILOT PLANT AND COMPONENT TEST LOOP DESIGN. Contract PH 86-67-128, PR-2, AI-70-10, 36p., 1970. CFSTI: PB 191962

Conceptual designs and cost estimates are given for two test systems, a Small Pilot Plant (SPP) and a Component Test Loop (CTL), which are part of the development program for the Molten Carbonate Process of sulfur oxides control. The SPP will be operated to test and evaluate the performance of the chemical reactors and to demonstrate process feasibility on an integrated basis under realistic plant operating conditions and on a continuous basis. Secondary objectives will be to study the effects of operational variation on plant performance and of trace impurities on process chemistry. Results will be used to develop specifications and operating criteria for a demonstration plant. The CTL will be operated to test equipment designed and supplied commercially (wherever possible) of a size comparable to those anticipated for the large pilot plant (a molten carbonate plant integrated into a 60-100 Mwe coal-fired unit). For both units, systems design, components, and layout are described and diagrammed in detail. Cost estimates cover only engineering and construction costs.

22869

North American Rockwell Corp., Canoga Park, Calif.,
Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART VII. PLANT ANALYSIS. Contract PH 86-67-128, PR-2, AI-70-11, 58p., 1970. 3 refs. CFSTI: PB 191963

Design, process description, integration with existing facilities, and capital and operating cost estimates are given for two installations to test the Molten Carbonate Process of power plant sulfur oxides control. The first is a large pilot plant to be integrated with one of the existing 60 Mwe generating units at the Watts Bar Station of TVA, at a total estimated cost of $3.2 million. The second is a prototype full size plant (800 Mwe), with a capital requirement of $11.6 million and an annual operating cost of about $3.9 million. Using hydrogen as the reducing agent, the overall system costs are estimated at 0.62 mils/kwh, not including any credit for sulfur. If fluidized coke were used as the reducing agent, the cost could be reduced to 0.42 mils/kwh. Detailed plant analysis studies are reported on integration considerations, comparative studies on the reduction step and fly ash removal, and on molten carbonate recovery. Unless nearly all of the fly ash is removed from the gas stream before it enters the scrubber, the carbonate melt must be recovered from the melt-ash filter cake for economic operation. (Author summary modified)

22871

North American Rockwell Corp., Canoga Park, Calif.,
Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART V. FLY ASH STUDIES. Contract PH 86-67-128, AI-70-9, PR-2, 30p., 1970. 4 refs. CFSTI: PB 191961

Investigations are reported on the physical properties of fly ash (particle size distribution, chemical composition, density, porosity, and solubility), and on methods for filtering the ash fro suspension in molten salts to permit recycling of the salts as part of a process in which they are used to remove sulfur dioxide and fly ash from flue gases. Fly ash particle density was close to that of the molten eutectic of lithium, sodium, and potassium carbonates. Mean particle densities were measured at 2.06, 2.11, and 1.96 cm/cu cm for three different coal fly ashes; bulk densities are also given. Fly ash porosity is about 50% for dry coal ash, 90% for fry oil soot, and 67% for melt-saturated coal ash. Sulfuric acid was a stronger leaching agent of coal fly ash than water. Coal fly ash is very sparingly soluble in the carbonate eutectic melt. Filtration studies indicated that almost all of the resistance to flow through the filter was due to the fly ash cake. A 10-micron filter removed virtually all the fly ash in suspension, with no more than 30 m suspended ash found in the filtrate. The sintered-metal medium is adequate for filtering fly ash particles from suspension in M2C03. Efficiency of filteration increased by accumulation on the filter, while at constant pressure, the flow rate decreased with ash accumulation. (Author summary modified)

22883

Singer, T. E. R.

FOREIGN LITERATURE DIGEST. Chem. Ind. (New York), 48(4):433, 514, April 1941.

An article in an Indian chemistry journal is summarized in which work done by several U.S.S.R. organizations on the elimination and use of sulfur dioxide from smoke gases is reported. The article gives a detailed discussion of two methods. The first entails absorption of SO2 in magnesium oxide, resulting in a reusable magnesium sulfite. It is practical for large power stations located near some contact sulfuric acid plant. The second entails acidification of SO3 in solution under the catalytic influence of metallic ions, in which the conventional MnSO4 is replaced by pyrolusite, containing Mn02, which is relatively inexpensive and does not poison the catalyst. Gas purification is completed with the lime method to produce a stronger acid (18-20%) than the 10-13% acid produced with the use of MnO2. With this acid-catalytic method, SO2 concentrations do not reach levels injurious to workers or the surrounding country, there are no dust processes; the quantity of waste products and waste water is small; and the process is extremely simple and easily regulated. Several commercial uses for the weak-acid end product are noted.

22884

Pagliari, M.

EXPERIMENTS WITH PILOT BALLOON SOUNDINGS AT SOME POWER STATION SITES. Phil. Trans. Roy. Soc. London, Ser. A, 265(1161):183-190, Nov. 13, 1969. 10 refs.

Data on the motion and layering of the lower atmosphere between 75 and 1500 m were obtained for three power station sites in Italy by use of a standard pilot balloon technique. On the shore of the Ligurian Sea with surrounding foothills, with north or northwest winds, the plume from a tall stack will be embedded in a thick body of moderately stable air, so that diffusion formulae can be reliably employed to derive the requisite height of a tall stack. On the bank of the Po River, in flat country, a plume emitted at about 200 m will develop above a very stable layer, effectively preventing any transport to the ground. Above 300 m, the likelihood of pollutant dispersion by wind is enhanced. Thus for new plants, stacks should be over 200 m high. In a 300-m hollow surrounded by 600-700-m ridges, analysis showed a discontinuity in the wind field. Meteorological conditions there cannot assist dispersion; thus, pollution control must be achieved at the source, in this case by additional electrostatic precipitators. It is concluded that despite the limitations of the method, pilot balloon sound is still a simple and economic method that in difficult situations can provide useful qualitative information no worse than that from inappropriate use of formulae.

22905

Juentgen, H.

PROCESSING ENGINEERING PRINCIPLES OF SO2 SEPARATION FROM FLUE GASES. (Verfahrenstechnische Grundlagen der Abscheidung von SO2 aus Abgasen). Text in German. Inst. Gewerbliche Wasserwirtschaft Luftrein-Haltung Forum, 1965:359-374, 1965. 21 refs.

Wet separation of sulfur dioxide from flue gases was unworkable because the cooling of flue gases by the washing liquid led to their loss of buoyancy and to subsequent accumulation of high levels of SO2 in the vicinity of the stack, in spite of its thorough separation. The main problem of SO2 separation lies in the large volume of flue gases from thermal power plants and the low SO2 concentration of from 0.5 to 1.5 ppm which is only 1% of the SO2 content in roasting gas. Processes recently proposed to solve these problems based on the reaction of SO2 with metal compounds to form sulfates, on the adsorption on carbonaceous adsorbents (semicoke and activated carbon) with a simultaneous conversion to sulfuric acid (the so-called clean air method, the Pauling, and sulfacid method), and on the catalytic oxidation of SO2 to SO3 on conventional vanadium catalysts with the subsequent washing out of the SO3 (methods developed by the Bituminous Coal Research Inc., and the Pennsylvania Electric Co.) are described. Some of these processes have been tried out on a pilot plant, semi-industrial and even industrial scale; their cost can at this point be only estimated. Experts are unamimous in the prediction that none of the processes proposed will be economically feasible; thus, the removal of SO2 from flue gases is still an expensive procedure.

22961

Novotny, Pavel

FLUID-BED COMBUSTION OF SOLID AND LIQUID FUELS AND WASTES. (Fluidni spalovani tuhych a kapaplnych paliv a odpadu). Inst. Fuel Research, no. 14, 59p., 1969. 42 refs. Translated from Czech. Belov and Associates, Denver, Colo., 57p., Jan. 30, 1970.

Fluid-bed combustion generally describes the oxidation reaction that takes place in the fluid layer. The fuels used can be solid, liquid, gaseous, or any combination of these. Some basic observations concerning fluid-bed technology are made. The basic types of fluid-beds are described. The theory of operation of the fluid-bed involves turbulent fluid flow and mass exchange. Mathematical relationships of fluid-bed phenomenon are determined. Fluid-bed combustion has the potential ability to effectively bind oxides of sulfur to alkaline additives by a drying method. It can also utilize a greater size range of coal fuel, and it reduces the ash content in the effluent. Designs of various fluid-bed reactors are given. Research into the combustion properties of various fuels is discussed.

22981

Basak, G. C.

STUDIES ON ASSAM COALS, PART I; CHEMICAL CONSTITUTION RELATING TO SULPHUR COMPOUNDS. J. Technol., 12(1):43-48, June 1967. 3 refs.

Because of their unusually high sulfur content, Assam coals are unsuitable for use as industrial fuel. As part of an investigation of the possibilities of recovering sulfur from the coals, studies were conducted of the chemical composition of the coals and of the effects of carbonization on their sulfur content. The results of both low and high-temperature carbonization showed that sulfur reduction was at a minimum where the percentage of ash increased during carbonization. This fact, coupled with their low pyritic sulfur content, suggests that Assam coals contain little or no inorganic sulfur.

23027

Bevans, Rowland S., Peter N. Renzi, and Yashwant R. Loonkar

METHOD OF REMOVING SULFUR COMPOUNDS AND RECOVERING HEAT FROM COMBUSTION GASES. (American Standard Inc.) U. S. Pat. 3,386,798. 4p., June 4, 1968. 2 refs. (Appl. Nov. 30, 1964, 5 claims).

In the method described for recovering heat and removing sulfur compounds from power plant stack gases, the gases are washed with a solution of 35-45% calcium chloride, the resultant hydrochloric is neutralized, and the calcium sulfur salts removed from the solution, which is then passed into indirect heat exhange with air for use in the combustion chamber. The calcium chloride solution has the advantages of having a higher evaporation temperature than ordinary water, is inexpensive, non toxic to personnel, and non-corrosive to plant machinery. Sulfuric acid vapor and sulfur dioxide are removed from the stack gases by reacting with the calcium chloride solution to form calcium sulfate, calcium sulfite, and hydrochloric acid, thus reducing pollutants emitted to the atmosphere and lessening the corrosive effects of the sulfuric acid vapor to the system.

23054

SULFURIC AS A UTILITY'S PROFITABLE BY-PRODUCT. Chem. Week, 103(6):51-52, Aug. 10, 1968.

A new electrolytic process has been developed to recover sulfur dioxide from power plant stack gases. The heart of the SO2 removal and recovery operation is a membrane-type electrochemical cell that generates caustic soda, sodium acid sulfate, dilute sulfuric acid, oxygen and hydrogen from a solution of sodium sulfate. The dilute sulfuric acid and oxygen become supplemental feed streams for a nearby sulfuric acid plant; the hydrogen can be bottled in cylinders for local markets. The recovery system has built-in tankage on either side of the cell room that permits about 760 hr/yr of absorption without cell-room power. For instance, if the peak load occurs late in the day on Wednesday or Thursday, absorption of SO2 can continue uninterrupted with the cells shut down. Then over the weekend, the cells could come on again and catch up, ready for normal operation on Monday morning. For a 1200-mw electric station burning 3.5%-sulfur coal, the investment cost of the process would be $18.5. To remove 90% of the SO2 from stacks, operating costs are set at $2,972,000. During the first year of operation, income from the sale of 99% sulfuric acid (340,000 tons) should total $5,810,000.

23140

Martin, J. R., W. C. Taylor, and A. L. Plumley

THE C-E AIR POLLUTION CONTROL SYSTEM. Nat. Eng., 74(6):8-12, June 1970. C-E'S AIR POLLUTION CONTROL SYSTEM. Ibid., 74(7):8-10, July 1970. 7 refs. (Presented at the Industrial Coal Conference, Lexington, Ky., April 8-9, 1970.)

Air pollution control systems were installed in two coal-burning, steam-electric plants. They are alkaline-additive, wet-scrubber type systems designed to remove both sulfur dioxide and fly-ash from the stack gases. Problems occurring during their operation, and modifications incorporated to overcome these problems are detailed. Throughout both systems, deposits of ash and scale were observed, and measures appropriate to the particular sector of the system in which they occurred were implemented. A problem common to all coal-burning installations, disposal of residue, is being studied with the objective of using the residue as a saleable by-product. Several potential applications are described, including use in light-weight aggregate, as an asphalt filler, a raw material for the production of mineral wool, and as a soil conditioner. Because of adverse experience with field modification with respect to time and expense, a one-quarter scale development model of the field installation was constructed and is being used to evaluate potential fixes for problems identified in the field. One of the field units has now been in essentially continuous use for 8 months; the other for 5 months. Sulfur dioxide removal has remained at about 60% without recycle and 75% with recycle.

23146

Yamada, Tsuyoshi

THE RESEARCH AND DEVELOPMENT OF AIR POLLUTION CONTROL TECHNOLOGY IN THE UNITED STATES. PART I. (America ni okeru taiki osen boshi n gijutsu no kenkyu kaihatsu. 1). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 6(5):282-287, May 25, 1970.

The process for removing sulfur dioxide developed by Combustion Eng. Inc., consists of the addition of dolomites and the four mechanical stages: heat exchanger, scrubber, another heat exchanger, and stack gas tower, respectively. The heat exchanger is for cooling the stack gas as well as for reheating treated gas. A glass marble bed about 76 mm deep is installed in the scrubber where sulfur dioxide is absorbed and stack gas is removed. The difficulty with this process is that absorbents such as CaO which fly in from the furnace are easily accumulated around the entrance to and exit from the scrubber. Repeated experiments revealed that the nonconstant velocity of the gas streaming into the scrubber is responsible. The marble bed also becomes clogged after several days of operations, resulting in the active formation of deposits in the demister and the reheater. The unbalanced distribution of gas in the marble bed is the cause of such deposits. TVA has been conducting various experiments for a long time to remove sulfur dioxides, and some of them can be listed as follows: the absorptio process by active carbon, the conversion of sulfur dioxide into sulfuric acid by using manganese dioxide as a catalyst, the production of high-concentration sulfur dioxide, and absorption by an ammonium salt solution. The process utilizing potassium phosphate possesses a great power to absorb sulfur dioxide.

23176

Jimeson, Robert M.

CENSUS OF FEDERAL COAL RESEARCH GIVEN AT SALT LAKE CITY MEETING. Mining Engineering, 15(11):51-55, Nov. 1963.

About 50% of coal consumption in the United States is in the production of electric power, 20% in the production of metallurgical coke, and over 20% in the production of process steam and power. The U. S. Bureau of Mines' Division of Coal Research places much emphasis on research that will maintain coal's leadership in these established areas. This emphasis is reflected in the following projects now underway: the possible utilization of a coal-fired turbine in conjunction with conventional boilers; the removal of dust from coal-generated gas by an electrostatic precipitator operating at turbine conditions; conversion of coal and coal gases in plasma; conversion of coal to high-Btu gas by direct hydrogenation and catalytic methanation; the application of nuclear process heat to the gasification of coal; purification of synthesis gas for high-Btu pipline gas; four types of reactor systems for catalytic hydrogenation of carbon monoxide; magnetohydrodynamic generation of power from coal; entrained carbonization processes for the production of char from coal; and the use of coal as a supplemental fuel for blast furnaces. The current status of these projects is outlined.

23220

Cadwallader, L. W.

COST, APPLICATION AND PERFORMANCE OF SERIES DUST COLLECTOR INSTALLATIONS ON LARGE PULVERIZED COAL BOILERS. Preprint, Smoke Prevention Assoc. of America, New York, 8p., 1952. (Presented at the Air Pollution and Smoke Prevention Association of America Annual Convention, 45th, Cleveland, Ohio, June 9-12, 1952.)

The efficiency of a mechanical collector increases with load, while the efficiency of an electrostatic precipitator decreases with load. For two pulverized coal-fired generating stations, the combination of electrostatic precipitators and mechanical collector into a series unit has resulted in a sustained high collection efficiency throughout a wide range of load. The series dust collector appears to be particularly well adapted for optimum fly ash collection. Of the two installations, the stacks at the station where the mechanical collector is placed before rather than after the precipitator present the most pleasing appearance. A capital expenditure of approximately $5.00 per nameplate KW is required to provide efficient series dust collector installations with necessary auxiliary equipment on large pulverized coal-fired boilers. This cost would be increased substantially where changes to buildings and foundations or the use of structural steel are required to accommodate the fly ash collectors and the additional loads imposed by them. Operating and maintenance costs for the two stations described are summarized.

23221

Hein, L. B., A. B. Phillips, and R. D. Young

RECOVERY OF SULFUR DIOXIDE FROM COAL COMBUSTION STACK GASES. In: Problems and Control of Air Pollution. O. S. Mallette (ed.), New York, Reinhold, 1955, Chapt. 15, p. 155-169. 12 refs. (Also: Chapman and Hall, Ltd., London.)

Feasibility studies of removing sulfur dioxide from steam plant emissions were undertaken at the laboratories at Wilson Dam, Alabama, and pilot-plant work was carried out on the absorption of SO2 by ammonia solutions. The major variables studied were the recirculation rate, pH, and concentration of the scrubbing liquor and the depth of packing and gas velocity in the scrubber. Equipment for burning pulverized coal, for cooling and humidifying the gas, and equipment for scrubbing the gas with an ammonium sulfite-bisulfite solution comprised the pilot plant. Recovery increased with increased recirculation rate up to about 5 gallons per minute and leveled off above this value, and as the pH was raised from 5.6 to 6.8, recovery increased from 0 to 90%. SO2 recovery was practically nil below pH 5.6, and the volatilization of ammonia was so great above 6.8 that constant pH could not be maintained. Increasing the pH would result in an increase in the proportion of ammonium sulfate and a decrease in the proportion of sulfuric acid produced as end products. The liquor rate require to obtain a given recovery increased as the depth of packing was decreased. At a pH of 6.4, recovery of SO2 decreased and the loss of ammonia increased as the concentration of the scrubbing liquor was increased. Data were obtained for calculating ash, sulfur, ammonia, and water balances for the period of operation. Tests of 5 to 12 hours duration indicated that virtually all of the ammonia could be recovered from the scrubber exit gas by scrubbing with dilute ammonium sulfite-bisulfite solution in a second stage tower. About 90% of the SO2 was evolved during acidification, while tests showed that the scrubber effluent could be acidified satisfactorily in a continuous flow manner. Crystallization tests were made in beakers to determine the purity of the ammonium sulfate produced and to indicate whether impurities would interfere with crystallization.

23231

Kleinschmidt, R. V.

FLUE GASES LAUNDERED TO PREVENT AIR POLLUTION. Power Plant Eng., 42(6):393-396, June 1938. 9 refs.

The large tonnage of sulfur dioxide now discharged into the air from power plant stacks, especially in the Midwest where high-sulfur coals are burned, creates a serious corrosion problem in industrial communities and is inimical to plant life over a wide area. The successful development of the Pease-Anthony scrubber, which has a high efficiency for both dust and SO2 removal, makes it advisable to consider wet treatment of flue gases in preference to electrical precipitators and cyclones. The Pease-Anthony scrubber consists of a vertical cylindrical chamber with a tangential gas inlet at the bottom and a central discharge collar at the top. Spray nozzles located along the lower portion of the axis of the cylinder discharge a fine spray of water or other washing fluid into the center of the rotating gas mass. The thoroughness of contact between liquid and dust particles is indicated by the fact that the gases are brought to equilibrium saturation temperature. The economics of SO2 removal depend largely on local conditions; under favorable conditions, recovery should be possible at practically no net cost to the power plant. Forms in which sulfur can be recovered for sale include sulfuric acid, sulfites and sulfates, and liquid SO2.

23237

Clarke, A. J.

THE APPLICATION OF AIR POLLUTION RESEARCH TO POWER STATION DESIGN. Phil. Trans. Roy. Soc. London, Ser. A, 265(1161):269-272, Nov. 13, 1969.

The objectives of research on power station emissions is defined as finding more effective, more reliable, or less costly ways of either reducing the rate or increasing the height at which potential pollutants are emitted to the atmosphere. Research problems in smoke and dust emission have been mainly practical ones dealing with improved design in available hardware, although the development of basic theory has progressed in parallel. Main interest now centers on gaseous pollutants, characterized by sulfur dioxide, where control is at present almost wholly achieved by high level dispersion. An important research result has been the dependence of plume rise on the heat content of the emission; for a given generating capacity, plume rise can therefore be maximized by concentrating all the flue gases into a single chimney. Thus, despite some engineering problems, nearly all new power stations planned since 1960 are provided with a single chimney. The large body of data collected from air pollution monitoring programs has been of great utility in developing effective control measures. Practical design of new power stations must take into account numerous factors besides the results of research, but research has contributed greatly to the relative 'cleanliness' of the modern power plant.

23262

Ito, Akio, Tadao Shirasawa, Tomio Ohyanagi, and Yukio Tamori

PACKED COAL BED AS A DUST COLLECTOR (II). Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):98-100, 1967. Translated from Japanese. 8p.

Dust collection using packed coal was studied for treatment of the exhaust of coal-fired furnaces and incinerators. The coal from which smoke was collected was fed into a combustion chamber, so that no dust trapping device was needed and operation could be achieved with only a single collector. Generally, in the case of filtration, collection efficiency is improved due to the deposition of smoke on the filter. However, the flow rate of gases is reduced due to thickening of the smoke layer, provided that the power of the suction or blower is maintained constant. Consequently, it is uncertain whether the rise of collection efficiency was due to formation of the dust layer or to the reduction of flow rate. In this experiment, the equipment was improved so that both effects could be separately evaluated. An experimental equation of pressure loss and collection efficiency was derived for a nearly uniform size of coal layer which was produced by sieving. An experiment was also conducted on packed beds of spherical active carbon and glass spheres in order to elucidate the feature of the coal bed in comparison with the above two standard beds. In this type of collector, the amount of coal employed for dust collection and that consumed for the combustion was balanced; this requirement imposed restrictions on the thickness of packed bed, flow rate of exhaust gas, area of beds, and interval for replacement of coal. For a given coal consumption, the gas flow rate was roughly determined, and the area of the bed was derived from the optimum face velocity. Beds of 7 and 14 cm thickness were tested. On determining the optimum thickness of the beds, the interval of time for the replacement of coal was derived. This procedure provided the standard for practical design of a coal bed. The smoke-laden gas of fixed volume was drawn through circular filters up and downstream of the smoke collector, and the amount of smoke was determined by measurement of light reflectivity of the filter surface on which the smoke was deposited.

23305

Lowe, H. J.

REDUCTION OF EMISSION OF POLLUTANTS. RECENT ADVANCES IN ELECTROSTATIC PRECIPITATORS FOR DUST REMOVAL. Phil. Trans. Roy. Soc. London, Ser. A, 265(1161):301-307, Nov. 13, 1969. 16 refs.

The basic theory of electrostatic precipitation is reviewed and discrepancies between theory and practice are commented upon. A working expression for particle migration velocity based on test data is presented. Three plant developments are discussed: The elimination of cyclone collectors ahead of the precipitator, the trend to almost flat electrodes, and a modest increase in the maximum gas velocity which eases the problem of precipitator volume associated with boiler size increases. A rather unusual complaint is that British precipitator performance is suffering from too low a sulfur content in the effluent gas. Below 1.3% sulfur, the conductivity of the particulates is adversely affected, and about 28% of the currently used coal is below that level. Research is in process to determine the optimum means of adding ammonium sulfate to the exhaust gas to control particulate conductivity. Rapping as a means of cleaning electrodes is analyzed as to force and frequency in the various zones of the precipitator.

23315

Billinge, B. H. M., A. C. Collins, J. Graham, and H. G. Masterson

REDUCTION OF EMISSION OF SULPHUR DIOXIDE. Phil. Trans. Roy. Soc. London, Ser. A, 265(1161):309-318, Nov. 13, 1969. 21 refs.

There is no immediate prospect of economic removal of sulfur from fuel before combustion in power plants. Residual fuel oil used in Britain has a sulfur content of about 2.5% and estimates of the cost of catalytic hydrogenation processes for sulfur removal range upwards from $3.40 per ton; in other terms, sulfur could be recovered from this source at about nine times the market price. Coal received by the Generating Board has a weighted mean sulfur content of 1.7%, comprising about 0.1% sulfate, between 0.6 and 1.0% organic, with the remainder mainly pyrites. It is possible to reduce the pyritic content by physical separation from pulverized coal, but none has yet been shown to be economically practicable. Many simple chemical reactions are being developed at this time as flue gas cleaning processes. There are unresolved difficulties in the application of the Claus reaction under power plant conditions, and processes based on catalytic oxidation of sulfur dioxide to the trioxide have so far been developed with more success. The Penelec /Monsanto process, currently operating on pilot scale recovers a marketable quality of sulfuric acid (78%) by condensation and precipitation of the acid mist from the flue gas stream. In a second scheme, ammonia is injected to the gas stream after the catalytic oxidation step, and ammonium sulfate recovered by electrostatic precipitation, or bag filtration. In Eastern countries, ammonium sulfate has a ready market as a fertilizer. The sorption-desorption of sulfur dioxide on carbon has also been developed on the engineering scale. In the Reinluft process, sulfur dioxide, which is retained on coke as sulfuric acid, is recovered by heating to about 400 C. Salt formation is the basis of several processes. The simplest systems discard the salt formed and schemes of this type are operating on full plant scale at two London power stations. The formation of calcium sulfate can also be achieved by injecting dry limestone into the furnace gas, as in the Combustion Engineering-Detroit Edison process; the sulfate in this case is recovered, together with fly-ash, in wet scrubbers which are packed with moving spheres to avoid plugging. The Fulham-Simon Carves process involves reaction of sulfur oxides with ammonia liquor, ammonium sulfate being recovered after autoclave treatment of the spent solution from the absorber towers. Interest is currently centered on the alkalized alumina process, proposed by the U. S. Bureau of Mines. It may be noted, however, that unlike the non-regenerative process, a regenerative process can produce a product which estimates suggest may actually approach in value, the operating cost of the plant.

23331

Paulson, C. A. J. and A. R. Ramsden

SOME MICROSCOPIC FEATURES OF FLY-ASH PARTICLES AND THEIR SIGNIFICANCE IN RELATION TO ELECTROSTATIC PRECIPITATION. Atmos. Environ., 4(2):175-185, 1970. 28 refs.

Examination of fly ash samples from five technical-scale tests and one full-scale test of electrostatic precipitation efficiency showed that collection efficiency decreased as the proportion of particles smaller than five micron increased in the fly ash entering the precipitator. When this proportion exceeded 45% by weight, the collection efficiency was unacceptably low (less than 98.5%). Superfine fly ash consisting predominantly of submicron particles was encountered in one test, apparently as a result of the high fusite content of the bituminous coal being burned. Such fly ash was especially difficult to precipitate. Particle shape was another factor influencing efficiency; spherical particles were collected more easily than non-spherical particles. It is suggested that increasing gas humidity might help promote agglomeration of superfine particles and that the addition of fluxing agents to the fuel during combustion could promote the formation of spherical particles. Lengthening particle residence times by increasing turbulence in the furnace might favor formation of larger ash particles. (Author abstract modified)

23373

Leithe, W.

REPORT ON METHODS FOR THE REMOVAL OF SULPHUR DIOXIDE FROM FLUE GASES. Chem. Engr. (London), 46(7):262-263, Sept. 1968. 4 refs.

A wet absorption process for purifying exhaust gases from sulfuric acid production by washing with ammonium sulfite-bisulfite solution at pH of 6 is briefly noted, and the most important and promising dry absorption processes for flue gas desulfurization are summarized (Reinluft, Sulfacid, Aluminate, catalytic H2SO4, and Mitsubishi) in table form. The economics of full-scale applications from pilot plant results are difficult to evaluate, but a rise of power generation costs of 10-25% has to be expected. At present, no process being studied for the removal of sulfur dioxide from flue gases is developed to the point where it can be recommended as technically satisfactory and economically feasible, and high stacks are still the only means for ground level control. The demand for byproduct sulfur is expected to rise and give impetus to further process development.

23374

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART I. PROCESS CHEMISTRY-REDUCTION. Contract PH 86-67-128, N.A.R.C. Rept. AI-70-5, PR-2, 103p., 1968. 48 refs. CFSTI: PB 191957

In the Molten Carbonate Process, the flue gases are scrubbed with a melt of alkali metal carbonates. This produces a melt mixture of alkali metal carbonates, sulfites, and sulfates, which must be treated to regenerate the carbonate and recover the sulfur. The first step of the treatment is the chemical reduction of the sulfite and sulfate to sulfide, using hydrogen, carbon monoxide, or carbon as the reducing agent. The chemistry of the hydrogen reduction step is studied in detail. The reduction is zero-order with respect to sulfate concentration, and the rate is catalyzed by iron, and autocatalyzed by the sulfide product. Increasing the temperature 100 C quadruples the reaction rate if no iron catalyst is present, and doubles the iron-catalyzed rate. Concerning the reduction reaction mechanism, the reaction does not take place in the gas phase; sulfate and sulfide combine to form the intermediate that undergoes reduction in the rate determining step; and the role of iron is one of either stabilizing the reactive intermediate (thus increasing its concentration) and/or acting directly in the reduction of the intermediate. Studies with carbon monoxide indicate it is not as reactive as hydrogen. However, its reactivity increases with pressure more rapidly than hydrogen, so it may be useful at high pressures. At temperatures above 700 C, carbon is an excellent reducing agent. At 800 C, complete reduction is obtained in 14 minutes using fluidized petroleum coke and an iron catalyst. (Author abstract modified)

23376

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART III. MATERIALS STUDY. Contract PH 86-67-128, N.A.R.C. Rept. AI-70-7, PR-2, 26p., 1968. 16 refs. CFSTI: PB 191959

The molten alkali carbonate eutectic consists of essentially equal parts by weight of lithium, sodium, and potassium carbonate. It may be used to control sulfur dioxide air pollution by scrubbing stack gases with the molten salt. The resultant fused salt contains sulfite which disproportionates to sulfate and sulfide. Suitable containment of these molten salts in water, carbon dioxide, and hydrogen sulfide gaseous environments is required for commercial development of this technique to control air pollution. The results of screening, medium-term and long-term static, dynamic, and thermal cycle tests are given. At 500 C, stainless steel (SS) 347 appears to contain all of the above melts satisfactorily. At 600 C, satisfactory containment of the melts with sulfur compounds present required low-iron, nickel or cobalt-based alloys with about a 20% chromium content, while SS 347 satisfactorily contains the pure carbonate melt. At higher temperatures, containment of these melts requires high-chromium alloys, ceramics, cermets, or a frozen skull of the salt. Materials for a small pilot plant are recommended, and the future corrosion program is outlined. (Author abstract)

23447

Kiyoura, Raisaku, Haruo Kuronuma, Yoshisuke Uenishi, Terunori Hayashi, and Nobuyuki Yamaguchi

RECOVERY OF AMMONIUM SULPHATE FROM SULFUR DIOXIDE IN HOT FLUE GASES (XI). WIDE RANGE APPLICABILITY OF DIFFERENT CONCENTRATIONS OF SO2 AND H2O. (Ryuan nado o fukusei suru Endohaigasu no jyogaiho (XI). SO2, H2O nodokohani ryoiki ni okeru tekiyo ni tsuite). Tokyo Inst. of Tech. (Japan), p. 1424, 1968 (?). Translated from Japanese. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 2p., Oct. 27, 1969.

The Kiyoura-T.I.T. process for removing sulfur dioxide from flue gas was studied for the effects of variations of SO2 and water concentration on the final by-product, ammonium sulfate. Increasin H2O from 10 to 20 vol% had no effect, while increasing SO2 from 0.1 to 2.0 vol% resulted in an exothermic increase during formation of ammonium sulfate. The results, which are graphically illustrated, demonstrate the applicability of the process for flue gases from oil combustion, coal combustion, petrochemical factories, chemical industries, and natural gas industries.

23504

Germerdonk, R.

WET-PROCESS REMOVAL OF SULFUR DIOXIDE FROM WASTE GASES. (Auswaschen von Schwefeldioxyd aus Rauchgasen). Text in German. Chem. Ing. Tech., 37(11):1136-1139, 1965. 5 refs.

A study is made of the amount of outlay required for the wet desulfurization of gases and the economic feasibility of such a process. The study utilized waste gases from a power plant fired with fuel oil, the sulfur dioxide content of which required reduction from 5 g/cu m to about 50 mg/cu m. The scrubbing process offers a considerable saving over that of earlier processes, but is very complicated. On the other hand, while providing about 99% reduction of the sulfur content, it generates a minimum of additional waste products. It has been estimated that the heat requirement for driving off SO2 from wash water at atmospheric pressure amounts to about half the heat requirements of the power plant involved. Recent attempts at improvement have aimed at reducing this heat requirement. The SO2-absorbing powers of water is very good for concentrations of less than 0.5 g/cu m of air, but the recovery of SO2 from the water can be expensive. One method of reducing this problem is by the addition of acid to increase the hydrogen ion concentration, which in turn decreases the SO2 solubility, facilitating its recovery. A flow chart is given, illustrating the recommended method of recovery, and equations are derived for calculating the vapor pressure of SO2 on the basis of dissociation factors. The recommended equipment is capable of accomplishing its task with about 10-12 liters of water per cubic meter of waste gas, with a waste gas throughput of 500,000 cubic meters per hour, at a cost of about 10% of the total plant operating cost; the waste water containing about 25 mg per liter of sulfite, and the sodium sulfite content amounts to less than 0.7%. The only chemical additive is sodium hydroxide in quantities of about 2.3% of the quantity required for a complete chemical reaction with all of the SO2 absorbed.

23526

North American Rockwell Corp., Canoga Park, Calif., Atomics International Div.

DEVELOPMENT OF A MOLTEN CARBONATE PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM POWER PLANT STACK GASES. PART II. PROCESS CHEMISTRY - REGENERATION. Contract PH 86-67-128, N.A.R.C. Rept. AI-70-6, PR-2, 152p., 1968. 7 refs. CFSTI: PB 191958

The regeneration of sulfide-bearing melts with carbon dioxide and water vapur is studied. The regeneration reaction can be carried to completion at 500 C in a batch process within practical time limits (20 to 30 min). The time required to complete the reaction is limited by the input gas flow rate to melt volume ratio and the effective equilibrium constant for the regeneration reaction. Foreign metal impurities in the melt reduce the sulfide activity in varying amounts, causing a reduction in the hydrogen sulfide content in the off-gas stream. Calcium impurity does not affect the regeneration process. The effect of iron, a potential reduction catalyst, is studied in detail. Iron causes melts to foam during regeneration under certain conditions, and also precipitates along with some sulfide during the regeneration process. The iron-sulfide precipitate can be completely recovered from the regenerated melt by filtration and reused as a reduction catalyst. The optimum rates and utilization of regeneration gases require low temperatures (less than 500 C) and carbon dioxide equilibrium pressure less than 0.5 atmospheres. The decrease in the effective equilibrium constant for the regeneration process with increase in carbon dioxide pressure is postulated to be due to the interaction of carbon dioxide with sulfide to form a series of thiocarbonates. Cycle tests show that the sulfur can be removed completely and reveal no problems due to cycling on the quality of the carbonate melt. (Author abstract modified)

23544

Tuentgen, Harald and Werner Peters

RECENT RESULTS OF THE RESEARCH ON EXHAUST GASES DESULPHURIZATION. (Neuere Forschungsergebnisse auf dem Gebiet der Abgasentschwefelung). Text in German. Staub, Reinhalt Luft, 28(3):89-93, March 1968. 13 refs. (Presented at the Verein Deutscher Ingenieure-Tagung, Schwerpunkte der Emissionsbekaempfung, Munich, Oct. 24-25, 1967.)

The two methods of sulfur dioxide removal from exhaust gases of hard coal power plants were studied: the adsorption on activated coke, and its binding to powdered metal oxides or carbonates blown into the exhaust gas. In the first case, SO2 is adsorbed on the coke surface and is oxidized to H2SO4. As the quality of coke used is the determining factor for the efficiency of the process, the preparation of suitable adsorbent and its properties were investigated. Hard coal coke produced by extrusion from pre-oxidized hard coal and with low flammability was most suitable. The laboratory conditions for optimum SO2 adsorption and binding were found. The possibility of large-scale production of this coke and its use in continual SO2 removal was considered. The advantages and drawbacks of three methods of coke regeneration were discussed. In the improved adsorption process coke was tested in 2 semi-industrial set-up. The method of SO2 removal by powdered metal compounds was less expensive; the material used in the process was not regenerated. The dosage of powdered CaCO3 or MgCO3 into the reactor results in SO2 or SO3 binding to them. The chemicophysical conditions of the process were studied in the semi-industrial set-up described. At stoichiometric dosage of CaCO3 and CaO powders into reactor at 800 C and at SO2 concentration of 1200 ppm, 50% conversion was achieved. The reaction kinetics in a non-isothermic conditions was studied on a laboratory scale to improve the utilization of powders used as desulfirizers.

23674

Kluge, Wolfgang and Boeho Koeppe

EFFECT OF USING ELECTROSTATIC FILTERS ON DUST EMISSIONS FROM LIGNITE-FIRED POWER PLANTS. (Einfluss des Elektrofilterbetriebs auf die Staubemission aus Braunkohlenkraftwerken). Text in German. Energietechnik, 17(12):530-535, Dec. 1967. 4 refs.

A series of experiments were conducted with two two-stage horizonta electrostatic filters made by a firm in Leipzig. These were connected to the exhaust line of boiler furnaces using lignite for fuel. The coal had a 51.5% water and 12% ash content. Determinations were made of changes in the degree of separating effectiveness over a long period of operation, and differences between filter equipment that had been cleaned and filter equipment that was dirty. Comparisons were made between the two filters, the second of which was equipped with a longer plate (8.5 m instead of 3.3 m), with a more recent type of electrodes and discharge points, and with a selenium rectifier, so that this filter operated at 400 mA and 75 kV, as compared with 200 mA and 40 kV for the first filter. Measurements obtained with the older-type filter were compared (with good agreement) with test results of 10 years previous, on the same type of equipment. Comparative tests with the second filter were made immediately after installation and about 6 months later. Dust content of the purified gases were determined as a function of filter current intensity at several states of filter current, from maximum down to zero mA. Further testing consisted in varying the operation of the discharge mechanism. Very little difference was noted between the two filters from the standpoint of 'clean' and 'dirty' operation, but from the standpoint of heavy-duty operation, the new filter gave as high as 26% better performance, with an average improvement of 6%. In the current range of 300-400 mA, it was found by extrapolation that the use of the new type rectifier permits a significant decrease in the dust content of the purified exhaust, amounting to as much as one third of the total content. Elimination of a filtering stage had a significant effect on the filtering efficienc of the electrostatic stage. When an earlier stage was omitted, the dust content of the filtered air was 3 times as high; when a filtering stage following the electrostatic stage was omitted, the dust content was 4 times as high. The article also discusses the effects created by varying the discharge time, the influence on filtering efficiency of the manner in which the plant is operated, and procedures for monitoring the operation of an electrostatic filter, such as by the measurement and recording of electric curren intensity.

23682

Bituminous Coal Research, Inc., Monroeville, Pa.

AN EVALUATION OF COAL CLEANING PROCESSES AND TECHNIQUES FOR REMOVING PYRITIC SULFUR FROM FINE COAL. (FINAL REPORT). NAPCA Contract PH-86-67-139, BCR Rept. L-362, 135p., Feb. 1970. CFSTI: PB 193484, 193532

An investigation into pyrite liberation and removal characteristics of U. S. coals, when pulverized to the two fine grinds of interest, is presented. Studies are also conducted on fine coal cleaning devices, notably the concentrating table and the compound water cyclone, to ascertain their potential for removing pyrite from fine sized coal. The use of the intermediate fractions lying between the clean coal and the high grade pyrite is studied. Additional information should be obtained on coal seams and/or areas that show potential for low-sulfur production. Results of the cleaning tests indicate that the pyrite in the finely ground coal is in the size range where poor separating efficiency is obtained, regardless of the method. A good grade pyrite concentrat can be made by a two-stage processing of the pyrite-rich refuse from the coal cleaning operation.

23708

SO2 REMOVAL FROM STACK GAS FEATURED AT APCA MEETING. Civil Eng. (N. Y.), 37(8):94, Aug. 1967.

A method of desulfurizing power plant stack gases was described at the June 1967 meeting of the Air Pollution Control Association in which a portion of pulverized, calcined alkaline earth is injected into the furnace with the pulverized coal, and the resulting compound is removed by wet scrubbing. The limestone doubled the amount of material recovered but did not reduce dust collecting efficiency. The method was claimed to remove 90-98% SO2 at an operating cost of 36 cents/ton coal, plus a capital cost of $2.20/kw plant capacity. A report on removing SO2 before combustion of Caribbean residual fuel oil gave an added cost of 72 cents/6.3 million-Btu barrel for reducing 2.6% sulfur content oil to 1%. An Illinois-Indiana Interstate Air Pollution Control Commission is being created by legislation in both states; a telemetered air-monitored network and closed circuit TV system with cameras have recently begun operation in the area.

23718

Wahnschaffe, E.

THE CONTROL OF POLLUTION, ESPECIALLY OF GASEOUS EMISSIONS. (Zur Reinhaltung der Luft, insbesondere von gasfoermigen Emissionen). Text in German. Inst. Gewerbliche Wasserwirtschaft Luftrein-Haltun Forum, vol. 65:352-358, 1965. 9 refs.

Atmospheric emission of sulfur dioxide in West Germany in 1963 was due to coal (79%) and to heating oil (21%). Power stations emitted 29% of all SO2. To keep SO2 within permissible limits, industry builds high stacks because emission concentration at ground level decreases with the reciprocal square of the stack height. The desulfurization of heating oil is expensive; oils with less than 2% sulfur content are advantageous.

Desulfurization of coal is not feasible; the use of coal with low sulfur content is desirable. The various processes in operation for the removal of SO2 from the industrial gases are reviewed. German experimental processes not yet accepted or introduced by industry include the Johwich process currently in pilot plant operation in which SO2 is absorbed by semicoke at 120 C and regnerated at 400 C; the iron oxide process in which SO2 is catalytically converted to SO3 at 200-450 C and the SO3 is converted to sulfate on an iron oxide saturated carrier (lab stage); the sulfacid process (formerly Pauling process) which absorbs SO2-containing waste gas at 60 C by active carbon, oxidizes it to SO3, and recovers sulfuric acid; and an additive process whic blows natural basic oxides or hydrates of oxides of alkaline earth into the furnace at 1400 C and converts thus all sulfur compounds to sulfates.

23757

Schwarz, Karl

SULFUR DIOXIDE EMISSIONS. (Schwefeldioxydemissionen). Text in German. Staub (Duesseldorf), 21(2):71-77, Feb. 1961. 29 refs.

The number and location of air sampling sites needed to establish the sulfur dioxide emission pattern and level of an individual enterprise, the pattern of SO2 emission from a high stack, the pattern of SO2 emission from a low emission source, the SO2 emission pattern in an industrial area with several emission sources, the frequency distribution of emission levels in industria areas, the superposition of SO2 emission from two stacks of different height, and the SO2 emission pattern in weather inversion are described. To reduce SO2 emission from furnaces, a balance between fuel sulfur content reduction, desulfurization of flue gases, and smoke dilution through the building of high stacks must be reached which, considering local circumstances, would keep SO2 emission within permissible limits at lowest cost. This will in most cases be achieved by a combination of measures as exemplified on a German electric power plant burning oil convertible to coal. Whenever weather inversion was of such long duration that the stack height was insufficient to handle SO2 emission, the plant was switched from oil to coal or its output was reduced. Another power plant was equipped with storage tanks for low sulfur content oil to replace its normally high sulfur oil in case inversions should generate too high SO2 pollution.

23773

Egger, Alfons

PROCESS FOR THE REMOVAL OF OXIDES OF SULFUR FROM GASES. (Verfahren zur Entfernung von Schwefeloxyden aus Gasen). Text in German. (Lonza Elektrizitaetswerke und Chemische Fabriken A. G., Basel (Switzerland)). Swiss Pat. 357,825. 5p., Dec. 15, 1961. (Appl. June 17, 1957, 4 claims).

Sulfur dioxide is removed from combustion gases of coal and mineral oil and of consumer gas by washing with an aqueous solution of ammonium sulfate, ammonium sulfite, ammonium bisulfite, and ammonium carbonate which is kept at a pH from 5.5 to 7.5 by additions of ammonia. Ammonium sulfite and bisulfite are formed, and sulfur is recovered in usable form. The washing solution which contains 400 to 600 g ammonium sulfate, 18 to 180 g ammonium sulfite, 15 to 150 g ammonium bisulfite and 1 to 3 g ammonium bicarbonate per l is kept in circulation while ammonium sulfate formed by oxidation is continuously precipitated. The 3-5% SO2 contained in the gas can by this method be practically completely converted to pure ammonium sulfate. The residual SO2 content in the gas is less than 0.0002% by volume. The gases enter washing towers at 150 -200 C and leave them at 45-70 C. The oxidation of the sulfite to sulfate is accomplished with air at the bottom section of the washing towers or in separate oxidation vats at relatively low temperatures without catalysts. A hundred kg solution yields 2-3.5 kg ammonium sulfate in one run.

23822

Tomany, James P. and Wilfred A. Pollock

SYSTEM FOR REMOVAL OF SO2 AND FLY ASH FROM POWER PLANT FLUE GASES. (Universal Oil Products Co., Des Plaines, Ill. and Wisconsin Electric Power Co., Milwaukee, Wisc.) U. S. Pat. 3,520,649. 7p., July 14, 1970. 4 refs. (Appl. Sept. 28, 1967, 10 claims).

A sulfur dioxide and fly ash removal system for coal burning power plant stack gases is described. The system provides for limestone- dolomite addition to the coal carrying through the power plant to form stable sulfate-sulfite compounds and unstable calcium and magnesium oxides which will carry along with the fly ash particles to a scrubbing zone. The fly ash and the sulfate-sulfite compounds are countercurrently contacted with a descending alkaline scrubbing stream in the presence of self-cleaning mobile contact elements in the scrubbing zone to effect the absorption of SO2 and physical removal of fly ash and the stable sulfate and sulfite materials. The continuously circulating alkaline stream used in the scrubbing zone is obtained in part from the reaction of portions of the calcium and magnesium carbonates and oxides from the limestone dolomite addition, with recirculating water. The advantages of this system over previous ones are that it removes fly ash as well as SO2, which wet scrubbers often do not do; it utilizes low-cost naturally occurring materials; and it has a high degree of efficiency. (Author abstract modified)

23867

Spicer, T. S.

SULFUR AND ITS EFFECT UPON COAL UTILIZATION. In: Report of Bituminous Research Activities. Pennsylvania State Univ., University Park, Dept. of Fuel Technology, Serial No. 57 Appendix p. 1-13, 1956. 5 refs.

Sulfur in coal is discussed with respect to its occurrence and its affects on the production of coke, steel, steam, and fuel gas all of which are deleterious. The removal of sulfur from coal during coal preparation is covered by the two statements: 'The only practical way to reduce the sulfur content of coal is by washing' and 'The sulfur content of this coal was actually increased by cleaning.' By-product recovery of sulfur from flue gas is considered the only way to meet air pollution control requirements. By-product recovery of sulfur is also considered as a means of reducing the cost of desulfurization of producer's gas. High pyrite residue from coal cleaning plants is mentioned as a potential raw material for sulfuric acid production, but short hauling distances, favorable freight rates, and a sulfur content in excess of 45% would be required to make the scheme economically attractive.

23879

Francis, W.

FLUE-GAS WASHING PROCESSES. PART ONE. Power Works Eng., vol. 41:17-21, 25, Jan. 1946. 2 refs. PART II. Ibid., vol. 41:37-40, Feb. 1946. PART III. Ibid., vol. 41:75-77, March 1946. PART IV. Ibid., vol. 41:103-105, April 1946.

Battersea was the first large power station in Great Britain required to install a flue-gas washing plant to remove the sulfur oxides and other strong acid constituents at a high efficiency. Th commercial process consists of washing the gases, first with natura river water in contact with rusty steel packing, then with river water containing in suspension additional alkali in contact with wooden packing. The rusty steel packing in the first scrubbers acts as a catalyst to promote the solution and oxidation of the sulfur dioxide, and it slowly dissolves and the iron in solution acts as a catalyst to promote oxidation in the subsequent aeration process. Additional alkali is added in a separate scrubber to remove the last traces of sulfur oxides. In the non-effluent system used at Fulham, no liquid is passed back to the river or drain. The washing medium passes down scrubbers containing suitable packing materials, and the hot flue gases pass upwards through the scrubbers. The sulfur oxides removed are neutralized by an alkali which forms a precipitate. This may be removed, together with the dust and grit washed from the gases, by settlement or filtration. Problems of designing the non-effluent plant are discussed.

23880

Stankus, L.

NAPCA'S SEARCH FOR FLUE GAS DESULFURIZING PROCESSES. Preprint, 22p., 1969 (?). (Presented at the Gordon Research Conference, Aug. 18-22, 1969.)

The National Air Pollution Control Administration's work on sulfur oxides and nitrogen oxides control is summarized by briefly stating the scope of major investigations, showing principal concepts generated, and indicating present achievements and possible future developments. There are several methods for desulfurizing flue gases under investigation, such as ammonia scrubbing and aqueous scrubbing. Organic liquids, such as olefins, carbohydrates, and amines, appear promising for extracting sulfur dioxide from flue gas. Solid organic materials including newsprint, sawdust, and cotton are capable of absorbing SO2. The most suitable catalyst for oxidizing SO2 to SO3 is vanadium pentoxide. Several methods for reducing SO2 to elemental sulfur were also investigated. Coal gasification was studied as a method for eliminating the varous forms of sulfur contained in coal. Methods for reducing nitrogen oxides emissions include catalytic reduction, staged combustion, and fuel combustion with oxygen. Combustion with low excess air, steam or water injection into the fuel burning zone, and flue gas recirculation into the fuel-air mixture were also investigated. A study on the availability and use of natural gas as a sulfur-free fuel for power generation was conducted. The principal chemical reactions that occur with these control methods are included.

23955

Underwood, G.

REMOVAL OF SUB-MICRON PARTICLES FROM INDUSTRIAL GASES, PARTICULARLY IN THE STEEL AND ELECTRICITY INDUSTRIES. Intern. J. Air Water Pollution (London), vol. 6:229-263, 1962. 57 refs.

The basic theory of electro-precipitators, fiber and bag filters, and venturi scrubbers is described, together with modern equipment capable of dealing with submicron dust particles. Difficulties involved in continuous operation at efficiencies over 99% are discussed with particular reference to the steel industry and power stations. However, the information presented should be applicable to small particles in general, and to any industry producing this fine dust. General conclusions drawn are that electro-precipitators are very suitable for collecting dust or fume with a resistivity between 10,000 ohm cm and 2 times 10 to the 10th power ohm cm. To ensure good operation, perforated distribution plates and turning vanes must be used to keep an even flow of dust and gas. Voltage should be maintained at its highest level by means of flat collecting electrodes with stiffeners at the edges of each sheet. Bag filters, especially those cleaned by a blow-ring and reverse jet can handle much higher dust loadings than electro-precipitators. Wool felt bags can handle gas up to 90 C; while silicone-treated glass bags, up to 300 C. The pressure drop of a bag filter can vary from 2 in. wg when clean to 6-8 in. wg when dirty; the pressure drop through an electro-precipitator rarely rises above 0.5 in. wg. The venturi scrubber is able to remove dust or fume of any size with efficiencies of over 99%, but pressure drops can increase to 30 in. wg. In general, venturi scrubbers have lower capital costs but higher running costs than electro-precipitators and bag filters.

23974

Kolbig, Joachim

PROBLEMS INVOLVED IN DETERMINING MINIMUM STACK HEIGHT ON THE BASIS OF METEOROLOGICAL AND AIR QUALITY CONSIDERATIONS. (Zur Problemat der Ermittlung meteorologisch-lufthygienisch begruendeter Schornsteinmindesthoehen). Text in German. Energietechnik, 17(12):547-549, Dec. 1967.

Large plants with a power output of more than 2000 MW, whose chimney height exceeds 150 meters experience difficulties. The basis for calculation is a formula of Bosanquet and Pearson, which gives pollutant concentration to windward of the source in terms of the quantity of pollutants emitted per unit time, wind velocity, distance from source, turbulence parameters, and effective stack height. This is applied to a discussion of power plants to be constructed in the future, such as plants burning lignite and producing electric power at the rate of 3000 MW and higher. Recommended stack heights are given in tables.

24001

Overcamp, Thomas J. and David P. Hoult

PRECIPITATION FROM COOLING TOWERS IN COLD CLIMATES. Massachusetts Inst. of Tech., Cambridge, Fluid Mechanics Lab., Grant NIH-1-ROI - AP 00 67-02, Pub. 70-7, 30p., May 1970. 18 refs. NTIS: PB 192626

The conditions causing precipitation from a natural draft cooling tower, used to control thermal pollution caused by waste heat from coal-fired and nuclear power plants, are analyzed. Precipitation from the condensation of water vapor is strongly dependent on the plume's trajectory, the flux of water vapor from the tower, and the ambient temperature and relative humidity. If the plume does not mix with the wake, there is no precipitation because the flow time is significantly shorter than the time to form rain drops. If the plume interacts with the wake and strikes the ground, there will be diffusion of small droplets to the ground. Calculations based on equilibrium thermodynamics and a simple diffusion model show that this can give a tenth of a centimeter an hour in cold weather. This could freeze and be hazardous to travel. These results can be used to predict precipitation for a natural draft cooling tower in a particular location. The probability of the plume striking the ground is first estimated using meteorological records for wind intensities, the performance of the tower, and an interaction chart which is given. This is combined with the local temperature records to predict the rate and frequency of precipitation. (Author conclusions modified)

24019

Riedel, Friedrich

PROCESS FOR MANUFACTURING SULFUR FROM GASES CONTAINING SULFUR. (Verfahren zur Erzeugung von

Schwefel aus schwefelhaltigen Gasen). Text in German. (Assignee not given.) Ger. Pat. 425664. 1p., Feb. 23, 1926. (Appl. Aug. 24, 1924, 2 claims).

In the process described for the recovery of sulfur from sulfur fumes, the sulfur-bearing gases are used as the atmosphere for combustion, with or without the addition of atmospheric air, in a burner unit utilizing oil or powdered coal as fuel. Catalysts may or may not be used. Illuminating gas, or an inert gas such as nitrogen, can be used as a carrier for the powdered coal. Sulfur is recovered in the elemental form.

24048

Dean, R. S.

PRESENT STATUS OF SULPHUR FIXATION AND PLAN OF INVESTIGATIONS. Bureau of Mines, Washington, D. C., Metallurgical Div., Rept. of Investigations 3339, p. 3-19, May 1937. 14 refs.

A review of the present technical status of sulfur dioxide control is presented. The problem is broadly met in one of two ways: dilution in the atmosphere, and by converting the SO2 to a liquid or solid and disposing of it in that form. No satisfactory proocess for recovering sulfur without preliminary concentration is known. Three processes for such concentration are known. They use as absorbents ammonium sulfite-bisulfite, basic aluminum sulfate, and xylidine and sodium carbonate solution. The formation of sulfate is a major problem in all three processes. It is removed as calcium sulfate in the first two and sodium sulfate in the third. The reduction step presents fewer problems than the concentration step. All three processes require cooling the stack gases. Investigations are recommended to improve these processes, and the development of an amine process that would show less reagent loss and satisfactory removal of sulfate is suggested. (Author summary modified)

24073

SOUTHERN CALIFORNIA EDISON LIMITS NO(X) WITH FIRING MODIFICATIONS, DISPATCHING TECHNIQUE. Elec. World, 174(9):32-35, Nov. 1, 1970.

Southern California Edison Company has taken the step of switching from economic load dispatching to dispatching all oil and gas- fired generating units for reduction of emissions of nitrogen oxides into the state's south coastal air basin. The cost penalty associated with this change in operations is estimated in excess of $1 million per year, but emissions of nitrogen oxides by Edison's nine plants in the basin will be reduced 20-25 tons per day. Although the Combustion Engineering boilers normally produce only 330 ppm of NOx while burning natural gas, tests conducted at Alamitos have shown that recirculating flue gas to the burner zone can reduce that level to below 150 ppm. Beginning about 1957, SCE and Babcock and Wilcox pioneered the development of two-stage combustion in wall-fired boilers, in which a portion of the air is diverted to auxiliary ports above the burners. The burners operate fuel-rich, and combustion is completed at lower temperature above the burner zone. Substitution of low-sulfur oil also reduced NOx from 500 to 200 ppm. Off- stoichiometric combustion and gas recirculation techniques have bee applied to achieve emission levels in the 150-200 ppm range. Combustion modification tests and test data are indicated.

24142

TVA RESEARCH ATTACKS WASTE RECOVERY, POLLUTION CONTROL. Chem. Eng. News, 48(44):89-90, Oct. 19, 1970.

Participants in the eighth biennial demonstration of fertilizer technology, held at the Tennessee Valley Authority's National Fertilizer Development Center, Muscle Shoals, Ala., were told of current environment related projects at the center. These projects include use of composted municipal waste as a soil conditioner, using by-products of phosphate rock processing in production of aluminum, and exploiting sulfur dioxide from power plant stack gases in production of sulfuric acid, phosphoric acid, and phosphatic fertilizers. TVA also has research under way in six closed watersheds in Alabama, Tennessee, and North Carolina in an effort to determine to what extent nutrients from fertilizers are involved in eutrophication.

24168

Martin, J. R., W. C. Taylor, and A. L. Plumley

C-E'S AIR POLLUTION CONTROL SYSTEM. Nat. Eng., 74(7):8-10, July 1970. 7 refs. (Presented at the Industrial Coal Conference, Lexington, Ky., April 8-9, 1970.)

Construction was recently completed of a laboratory facility for testing Combustion Engineering's air pollution control system. Principal components of the system are a wet scrubber, heat extractor, reheater, demister, clarifier or retention tank, slurry or mixing tank, additive and fly ash injector system, wet grinder, and vacuum filter. Piping and pumps are arranged to allow the system to operate in several different modes. Test work currently underway is directed toward resolving remaining problems on demonstration units installed in power plants. Future work will focus on industrial applications, design criteria for future systems, and by-product utilization of sludge.

24181

SO3 INJECTION TO AID STACK CLEANUP. Elec. World, 173(26):22-24, June 29, 1970.

While many utilities face increasing problems with sulfur oxides in plant stacks, Public Service Company of Oklahoma finds itself forced to add sulfur trioxide to aid particulate removal. The problem is that the high resistivity of the fly ash from western coal prevents it from being properly neutralized on the collector plates of precipitators. Coal burned by PSC produces only 5 ppm of SO3, while experimental work indicates that 20 ppm of SO3 are sufficient to coat the fly-ash particles so that they are readily ionized and collected at the plates. Universal Air Products will supply a $140,000 SO3 injection system for Arapahoe No. 4, a 110-Mw unit, while the Western Precipitator Division of the Joy Manufacturing Company will supply an SO3 vapor injection system for the 150-Mw Cherokee unit NO. 3. Lodge-Cottrell will manufacture and install a complete SO3 conditioning plant for Cherokee Units 1, 2, and 4 at a total estimated cost of $500,000. Flow diagrams are provided for the latter two systems. An additional gas conditioning installation will include a scrubber, while the 'hot-gas' precipitator is also mentioned.

24190

Bender, Rene J.

HOW TO KEEP AN OIL-FIRED PLANT FROM POLLUTING. Power, 114(11): 112, Nov. 1970.

Control of emissions from oil-fired power plants is reviewed. Most plants of a Pennsylvania electric company, in order to meet sulfur limitations of fuels, had to be converted to oil. Problems arose concerning the lower superheated steam temperature, vibration of suspended heating elements, and the offensive color of stack plumes. A thorough study of oil fuel combustion must be made and steps taken, if necessary, to modify air arrival, burner location, and oil viscosity. Mechanical collectors or electrostatic precipitators must be watched to prevent fires and blockages. The use of a magnesium-based additive has been successful in certain units to inhibit vanadium corrosion and fly-ash acidity.

24207

Shidara, Masao

LECTURE ON PUBLIC NUISANCE: SO2 GAS POLLUTION CONTROL. PART II. (Kogai boshi koza: dainiko aryusan gasu taisaku - ge). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(9):35-48, Sept. 30, 1970.

Purification of exhaust fume, the problems of low sulfur heavy oil, and the desulfurization of heavy oil are discussed. Sulfur in fuel turns to sulfur dioxide gas through combustion and 1-5% of the gas is oxidized to sulfuric anhydride; its elimination is the subject of the present lecture. Industrial methods for desulfurization under development are divided into the following items: wet absorption (ammonia water method); dry absorption (manganese oxide method); adsorption (active carbon method); and contact oxidization (vanadium catalyst method). Addition of lime into the furnace is the cheapest method of removin sulfuric anhydride, and the joint use of lime water to clean smoke increases the efficiency of purification. Improved ammonia water method was developed for a steam power plant. Ammonia gas is reacted with sulfur oxides and jet flow of fine particles of ammonia water to collect the aerosol products. A method is being developed for sintering furnace using ammonia water curtain to pass sulfur dioxide gas through it. Dry desulfurization was mainly developed for a power plant, since the wet method causes the contamination of the area around the plant at certain weather conditions. High collection efficiency of the dry method using lime is reduced by the sticking of lime to the boiler wall for a long-period operation. The collection efficiency of alkalized alumina method reaches 90%. High absorptive power of MnOx.nH2O(x equals 1.5-1.8 n equals 0.3-1.0) was discovered and is being applied to a power plant. Sulfur dioxide gas adsorbed on active carbon turns to sulfuric acid and is washed by water. Contact method or the process for production of sulfuric acid is also used for purification of gas. The difficulty of obtaining low sulfur crude oil supply requires the desulfurization of heavy oil. The direct, indirect and intermediate method are mainly used for hydrogenating C-heavy oil. The direct method is simple and effective.

24253

Young, Stewart Woodford

PROCESS OF REDUCING SULPHUR DIOXIDE AND RECOVERING THE SULPHUR. (Assignee not given.) Can. Pat. 147,882. 8p., May 13, 1913. (Appl. Oct. 11, 1912, 4 claims).

A process is described which consists in subjecting sulfurous fumes to the action of a heated carbonaceous fuel in the presence of a solid reagent capable of neutralizing the sulfur dioxide. The decomposition or reduction of the sulfur dioxide, and consequently the formation of sulfur, is accelerated by the presence of lime, lime rock, or any other sufficiently basic material. Small quantities of oxides or salts of iron, copper, manganese, and many other metals may also be added to increase the activity of the basic materials, thus acting as catalytic accelerators. A temperature of 700 C is suitable for the reaction.

24269

Seki, Michiharu, Yyoko Yamamoto, and Katsuhiro Kaneko

ADSORPTION OF SO2 BY CARBON ADSORBENT (I) MEASUREMENT OF SO2 ON ACTIVATED CHARCOAL IN EXISTENCE OF H2O AND O2. (Tansokei kyuchakuzai no SO2 kyuchaku (dai 1 ho) H2O, O2 kyozon ka ni okeru kasseitan no SO2 kyuchakuryo no sokutei). Hitachi Manufacturing Co. (Japan), Central Inst., p. 1418, 1969 (?). Translated from Japanese. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 3p., Oct. 27, 1969.

An investigation was undertaken to abate sulfur dioxide from stack gases of thermal power plants by adsorption with activated charcoal. Four balloons were filled with SO2, oxygen, carbon dioxide, and nitrogen. Changing SO2 density and adsorption time, the amount of quantity adsorbed was measured at 100 C, and total adsorbed gas was obtained by expansion of a quartz spring. Sulfur dioxide that is extracted at 400 C and mixed with 3% hydrogen peroxide solution is measured by alcoholic titration. Total adsorption increases linearly until it arrives at 20% by weight. Its velocity is much slower than normal physical adsorption but increases in proportion to SO2 density. While the total adsorption quantity increases in proportion to time, the ratio of SO2 to total adsorption is constant at any time. The value of this ratio is decided by adsorption temperature and water vapor density and is 0.5 at 100 C with 10% H20.

24270

Girsewald, Conway Freiherr von, Gerhard Roesner, and Josef Barwasser

METHOD FOR THE RECOVERY OF ELEMENTARY SULFUR FROM SULFUR DIOXIDE OR FROM SULFUR DIOXIDE CONTAINING GASES. (Verfahren zur Gewinnung von elementarem Schwefel aus Schwefeldioxyd und solches enthaltenden Gasen). Text in German. (Metallgesellschaft A. G., Frankfurt (W. Germany)) Ger. Pat. 715,845. 5p., Dec. 4, 1941. (Appl. Aug. 11, 1936, 3 claims).

Elementary sulfur is obtained by passing the gas to be converted through a layer of carbonaceous fuel (coke or coal) in a shaft furnace without external supply of heat. Sulfur dioxide is reduced quantitatively to sulfur when the ratio of gas velocity and of the fuel layer thickness is regulated in a way which does not permit the temperature of the gas leaving the fuel layer to reach 800 C. The resulting gas mixture which, following the removal of elementary sulfur, contains a mixture of carbon monoxide, carbon dioxide, and carbon oxy-sulfide is in a second step mixed with the necessary quantity of SO2 and/or air and heated in the presence of a catalyst (bauxite) up to about 700 C, whereby COS is oxidized to elementary sulfur and CO to CO2. The gases entering the reduction chamber are preheated by heat exchange with the gas leaving the reduction chamber.

24290

Pichel, Walter

TESTING OF FABRIC FILTER AND HYDRAULIC DUST REMOVERS. ASHRAE (Am. Soc. Heating, Refrig., Aircond. Engrs.) J., 6(6):87-93, June 1964. (Translated Condensation of an article by J. Patary, Rev. Gen. Thermique (Paris), May 1963.)

Tests were made on two models of hydraulic dust collectors for removing impurities from steam generators. One model (A) uses a fabric filter in the form of a sleeve and the other model (B) uses the fabric in the form of a pocket. In A, gas arrives at the bottom of the unit and is divided between four cells, each equipped with 17 sleeves that are open at the bottom. The gas passes through the fabric and is evacuated at the upper part. The lower ends of the sleeves are attached to sheet metal collars, while the upper ends are suspended from a movable mechanism that permits vertical shaking of the filters. Model B consists of two cells in which sleeves are replaced by pockets 60 mm wide and 1500 mm long. The pockets are suspended from metal frames mounted on springs, their lower parts hanging freely. Gas enters by the lower part of the unit and penetrates the pockets from the outside. The unit is cleaned with only a counter-current, pulsating air flow that causes a horizontal vibration of the pockets. Test results are summarized in the form of curves of friction losses for both models. Polyacrilic filter sleeves gave highly satisfactory results (above 99% efficiency, but both polyacrilic and polyester pockets became clogged, leading to high friction losses for B. Tests with both models are continuing.

24397

(Inventor not given.)

PROCESS FOR RECOVERING ELEMENTAL SULFUR FROM SULFUR DIOXIDE AND FROM GASES CONTAINING IT. (Procede pour retirer du souire elementaire de l'anhydride sulfureux et de gaz en contenant). Text in French. (Metallgesellschaft A. G., Frankfurt (West Germany)) French Pat. 825,289. 8p. Feb. 8, 1938. (Appl. Aug. 7, 1937, 4 claims).

The process involved is that of reduction of sulfur dioxide at a high temperature, using coal, coke, or some other carbonated solid. The SO_2 is passed through a furnace with no external heating, passing through a column of the fuel, the speed of the gas and the dimensions of the column being such that the gas leaving the column contains practically no free sulfur dioxide and does not exceed a temperature of 800 C. The emerging product contains a higher concentration of SO_2 than the raw material (at least in the case of a mixture) and also contains carbon monoxide, which is then oxidized to carbon dioxide, at the same time reducing the sulfur dioxide to elemental sulfur. This is submitted to supplementary treatment in the presence of a catalyst and at a temperature above the melting point of sulfur (about 700 C). Additional oxygen is mixed with the SO_2 mixture before or at the time it enters the reaction chamber, so as to promote heating to an adequate temperature without the use of exterior heating. It may also be advantageous to preheat the gas containing SO_2 before it enters the reaction chamber.

24441

Emicke, Kraus

METHOD TO REMOVE SULFUR DIOXIDE FROM WASTE GAS. (Haigasu kara nisanka iou o jokyo suru hoho). Text in Japanese. (Nor Deutsche Affinerie, Hamburg (Germany)) Japan. Pat. Sho 43-7682. 4p., March 23, 1968. (Appl. June 18, 1965, claims not given).

Use of a selenious acid solution makes it possible to almost completely remove sulfur dioxide from power plant waste gases. This process is carried out in a disposal chamber through which the waste gas is conducted, and in which the SO_2 laden gases are exposed to the selenious acid solution by scrubbing. Removal of the SO_2 is based on a reaction in which selenious oxide and sulfur dioxide react to form selenium and sulfur trioxide. Economical and practical, this method is based on the fact that selenium separates out in a solid form without dissolving in the sulfuric acid which is produced simultaneously. To make the process still more economical, waste gases can be deprived of toxic solid components and then treated with the selenious acid solution. The first stage of the process then would consist of a continuous recycling of the washing liquid until it contains no more selenious acid. In the second stage, a stoichiometrically excessive quantity of selenious acid is utilized, while selenium is simultaneously and continuously being separated out. Solid seleniu produced in both stages is oxidized and is returned to the second stage.

24458

Sperr, F. W., Jr.

GAS PURIFICATION IN RELATION TO COAL SULPHUR. Proc. Intern. Conf. Bituminous Coal, Pittsburgh, Pa., Nov. 1928, 37-64. 27 refs.

Gas purification in relation to coal burning operations nearly always means removal of hydrogen sulfide, in which form most of the sulfur occurs. The dry purification method consists of passing the gas through a series of boxes filled with hydrated iron oxide and a filler material. The wet process involves contacting the gas with a scrubbing agent to wash out the H_2S. Neither of these methods removes any appreciable amounts of organic sulfur compounds such as carbon disulfide. A catalytic process is necessary to convert the carbon disulfide to H_2S, which is then removed by standard methods. The cost of sulfur removal from coal gas by each of the previously mentioned methods is related. The distribution of sulfur in coal gas manufacture depends upon several operational factors, which are described in detail. The effect of sulfur on coke quality is generally a more important consideration than its effect on cost. The problems associated with sulfur in water gas are discussed. A discussion of several technical and industry-related problems is included.

24480

Pennsylvania State Univ., University Park, Dept. of Fuel Technology

ADAPTATION OF THE EFM FIRE-JET STOKER FOR BITUMINOUS COAL. In: Report of Bituminous Research Activities. Serial No. 57. Proj. 392-B-7, p. 30-49, 1956. 2 refs.

Modifications to a stoker and boiler are described along with the tests to determine the effects of the modifications. The modifications include the installation of a water-cooled coal feed throat to reduce coking, installation of over-fire air jets for improved air diffusion and reduction of particulate emissions, addition of coal pushers to break up coke formed in the feed throat shortening of the grate to speed coal ignition, installation of a refractory arch, insulation of the boiler, and modification of the draft controls to reduce back-burning. The combination of changes made it possible to obtain 95% or better boiler ratings during eleven tests with ten coals. The highest boiler rating was 150%. Efficiencies of the eleven tests ranged from 65.2 to 73.4%. Refuse ash ranged from 63.5 to 82.1%. Fly-ash deposited in the dust collector ranged from zero to 0.23 pounds per 100 pounds of coal. Carbon dioxide content of the flue gas varied from 6.1 to 12.9%. A series of cyclic tests was run to obtain efficiencies under various typical operating modes. These data are presented tabularly. An attempt to correlate two common coal performance tests, free swelling index and specific volatile index, provided scattered data points and no definite relationship. The burning rate of most coals tested was doubled by the stoker modifications. The percent boiler rating was increased by more than 100% in most cases. The efficiencies obtained were better than those of small, single-retort stoker fired boilers of the same size-class. The refractory arch appeared to be the most important modification. It improved ignition, combustion, and efficiency and substantially increased the burning rate. Also, it costs less, lasts longer, and gives better results than a stainless steel arch.

Overfire air jets were effective in reducing smoke. The useful function of the coal pushers is limited to the first few minutes of each 'on' period. The length of the grate is important insofar as time for complete combustion is involved, but specific dimensions are not ye established. The value of the water-cooled coal feed throat is questionable.

24516

Benner, Raymond C. and Alfred Paul Thompson

METHOD OF RECOVERING SULPHUR. (General Chemical Co., New York, N. Y.) U. S. Pat. 1,771,480. 6p., April 16, 1935. (Appl. July 13, 1932, 25 claims).

A more efficient and economical process is provided for the reduction of sulfur dioxide gas to hydrogen sulfide by the utilization of flow-temperature coke. Previous processes involved incandescent coke and a considerable amount of water vapor to be present, requiring additional heat which increased the cost of operation. By causing the SO2 containing gases to first pass through a heated zone in which are present substantial amounts of hydrocarbons, then subsequently passing the products of this zone through a bed of heated carbon, it is possible to carry out the reduction of SO2 to elemental sulfur at substantially low temperatures and to obtain a considerably higher rate of reduction. As the bituminous coal enters the heated zone a coking operation takes place which liberates substantial amounts of hydrocarbons to initiate the reducing action. The coking operation, because of the relatively low temperatures involved, results in the production of a low temperature and very active coke. Furthermore, this volatile matter serves to prevent the formation, or provides for the decomposition, of any carbonyl sulfide.

24554

Girsewald, Conway B. von, Gerhard Roesner, and Josef Barwasser

A PROCESS FOR THE RECOVERY OF ELEMENTARY SULPHUR FROM SULPHUR DIOXIDE AND GASES CONTAINING SAME. (Assignee not given.) Can. Pa 384,396. 17p., Oct. 3, 1939. (Appl. June 6, 1937, 17 claims).

A process for extracting elemental sulfur from a gas containing sulfur dioxide is described, which comprises contacting the gas with a solid carbonaceous substance at an elevated temperature. Th gas is passed through a shaft furnace charged with coal, coke, or other solid carbonaceous reducing agent and operated after the manner of a producer without external heating. A layer of fuel is used of such a depth and the rate of flow of the gas in the layer of fuel is so regulating that the gas issuing from the latter contains practically no more SO2, and the temperature of the gas at its point of issue from the fuel does not attain 800 C.

24565

Lindblad, Axel Rudolf

A METHOD OF PRODUCING SULPHUR THROUGH REDUCTION OF GASES CONTAINING SULPHUR DIOXIDE. (Assignee not given.) Can. Pat. 363,638. 10p., Jan. 26, 1937. (Appl. date not given, 6 claims).

An improved method is described of producing sulfur from roaster gases containing hydrogen sulfide by reduction of sulfur dioxide with producer gas. The gases containing hydrogen sulfide and a suitable quantity of oxygen are fed into a gas generator, the charge of which consists of a carbonous material admixed or impregnated with a suitable quantity of alkali or alkali compound. Alkali and the alkaline compounds may consist of sodium carbonate, sodium sulfate, or sodium sulfide. The carbonaceous material forming the charge of the gas generator may consist of coke, pit coal, or charcoal. A temperature between 700 and 1100 C is recommended. Since the heat liberated in the process originates exclusively from the reaction of the oxygen contained in the gas mixture with the carbonaceous material, it is thus possible to set the temperature at a desired number of degrees by regulating the percentage of oxygen in the gas.

24589

Uno, Tsukumo, Hiroshi Yamada, Masao Higashi, Saburo Fukui, and Masumi Atsukawa

A NEW DRY PROCESS OF SO2 REMOVAL FROM FLUE GAS. Proc. World Petrol. Congr., 7th, 1967, p. 289-295. 3 refs. (May 1967.)

A new dry process for removing sulfur dioxide from power-plant flue gases entails contacting the gases with powdered, activated manganese oxides in a fluidized or moving bed absorber. The resulting manganese sulfate and excess of unreacted absorbent are collected in a mechanical separator and electrostatic precipitator installed in series. The greater part of the collected absorbent is returned to the absorber as recycle solids; the remainder is regenerated, and ammonium sulfate is recovered as a by-product. In the regeneration process, the slurry containing manganese sulfate solution and unspent absorbent is first contacted with ammonia-containing air and then delivered to an oxidation tower equipped with an air atomizer, where manganese sulfate is oxidized to activated manganese oxide. Excess ammonia is fed to the tower. When tested in a pilot plant treating 3000 cu Nm/hr of flue gas, the efficiency of the process for SO2 removal was greater than 90%. Capital costs of the process for a 1000 MW oil-burning plant are estimated at $15,500,000, and net operating costs at 0.23 to approximately 0.20 mills/KWhr.

24609

Fried-Krupp, Essen (West Germany), Zentralinstitut fuer Forschung und Entwicklung

METHOD FOR THE SEPARATION OF PYRITE FROM COAL. (Verfahren zur abscheidung von Pyrit aus Kohle). Rept. 41/69, 19p., 1969. 7 refs Translated from German. Belov and Associates, Denver, Colo., 23p., Feb. 23, 1970.

Investigations of untreated coal which were conducted in different countries indicate that the pyrite percentage of the total sulfur content of coal is so high that mechanical separation could result in a significant reduction of the sulfur content. Separation is technically possible and economically feasible as pyrite occurs at an average of 80-90% in a particle size larger than 20 micron. Wet methods (gravity and centrifugal separation, gravity turbidity methods, and flotation) should have preference because of their operational and throughput efficiency. In connection with the trend towards the hydromechanical production of coal, direct burning of mud in power stations is discussed. The use of atomic heat is being contemplated to reduce the cost of drying. The selection of installations for sulfur removal is discussed according to the particle size region of interest. If the sulfur content of the initial coal can be reduced by at least 30-40%, and if the operational costs of the sulfur removal amounts to approximately 5 to 35 cents per ton product, then it is profitable to provide mechanical pyrite separation methods. (Author conslusions modified)

24613

Bernhoff, R.

EXPERIENCES WITH THE USE OF LIME IN FLUE GAS DESULFURIZATION. AB Cementa, Malmoe, Sweden, 39p., 1970. 43 refs.

Several limestone addition methods of controlling sulfur dioxide ar discussed. There are two types of such processes wet and dry. In the wet process a slurry of lime is introduced directly into a scrubber. The SO2 reacts to form calcium sulfite or sulfate. In the dry process, pulverized limestone is blown directly into the boiler, where it reacts to form calcium or magnesium sulfite or sulfate. The dry process is only about 50% efficient, so it is used primarily with low sulfur fuels. The general term limestone covers a range of compounds containing calcium and magnesium. Most tests show that dolomitic limestone is not as effective as hig calcium limestone. The sorption rates of various limestones vary, depending on particle size, precalcination, temperature, point of injection, and stoichiometry. Several operating power plants which have limestone control processes are described, including two plants in the U. S. and one in Sweden. Cost studies of the operations are given, including the cost of solid waste disposal and potential recovery methods.

24630

Durie, R. A. and E. C. Potter

FACTORS INFLUENCING THE EFFICIENT OPERATION OF ELECTROSTATIC PRECIPITATORS FOR PULVERISED-FUEL ASH. Australian Chem. Process. Eng. (Sydney), 23(9):18-19, 21-23, 25, 27, Sept. 1970. 15 refs. (Presented at the Clean Air Conference, 1968.)

Fly-ash from bituminous Australian coals are difficult for power plants to precipitate at the desired efficiency of 99.9% or more. Practical precipitation technology has to recognize an interplay of fly-ash precipitation and dislodgement in plant design and operatio It is now almost always necessary to induce the dislodgement of collected fly-ash by rapping or vibrating collector plates mechanically, and this deliberate dislodgement of the fly-ash layer is inevitably accompanied by a re-entrainment of loose outside particles. The release of a large quantity of such particles following simultaneously rapping of many collector plates can place a sudden and unmanageable burden on subsequent collector plates. I the differentials of cohesive strength through the thickness of the growing fly-ash deposits can be controlled, there arises some opportunity to perfect the technique of dust-dislodgement. In this connection, it is possible that electrolytic conductors advocated as additives for improving precipitator efficiency raise the cohesive strength of the fly-ash to levels that inhibit entrainment On the other hand, cohesive strength also depends on particle size, size distribution, and packing density. A beneficial combination of these variables may cancel any electrical difficulties that smaller particles experience in being precipitated.

24642

Knapp, Otto and Hans Luettger

DESIGN CHARACTERISTICS AND TEST RESULTS OF A NEW MULTICELL FILTER. (Konstruktionsmerkmale und Versuchsergebnisse eines neuentwickelten Vielzellenfilters). Text in German. Wasser Luft Betrieb, 14(9):358-360, Sept. 1970.

In order to stay within limits of the maximum permissible dust emission in the case of a Vekos-Powermaster boiler, a dust extractor was developed characterized by a filter housing with a comparatively large number of cells in the filter housing and by a strictly tangetial direction of the raw gas flow with relatively small velocity (9.5 m/sec). The cells are small diameter cyclones with the flue dust being returned to the furnace. The combustion air purified by this filtering arrangement contained dust levels of between 140 and 236 mg/ N cu m when bituminous coal was used as fuel. The construction has unusually low resistance because of the unhindered inflow of the gas into the cyclones and because of the low gas velocity. The arrangement was tested on a boiler with a mechanical firing mechanism of 80% efficiency, fired with bituminous coal nut size 3 and 4, an ash content of 3.7%, and a 3.1% H2O content. The raw gas dust content was 0.882 g/ cu m; the purified dust gas content, 0.074 g/ cu m; and the efficiency of the cyclone dust arrester battery, 91.65%.

24643

Furuto, K.

DISPOSAL METHOD FOR SULFUROUS ACID CONTAINED IN WASTE GAS. (Haigasuchu no aryusangasu shoriho). Text in Japanese. (Toa Gosei Chemical Industry Co. (Japan)) Japan. Pat. Sho 22-528. 2p., June 8, 1948. (Appl. Dec. 12, 1943, claims not given).

Waste gases emitted by sulfur manufacturing plants contain relatively large amounts of sulfurous acid. To remove the acid, such waste gases are conventionally treated with ammonia solution or flowers of zinc. Disposal costs are high for both methods. Since sulfurous acid gas is water soluble, another suggested method is to remove it by washing the waste gas with water in combination with certain chemicals. But again, this method is not economical because it needs a tremendous amount of water. The invention described provides new disposal method in which waste gas containing sulfurous acid is washed with water mixed with coal dust obtained from a plant manufacturing producer gas from coalite or coal. The carbonic content of coal dust possesses adsorptive as well as contact oxidation powers with respect to sulfurous acid; the ash content can neutralize sulfurous acid. Utilization of the dust is an inexpensive solution to the problem of removing sulfurous acid from waste gas.

24673

Asano, Toyoshi

DISPOSAL OF WASTE GAS CONTAINING DELUTE SULFUR OXIDE. (Kihaku sanka iou ganyu gasu no kaishu). Text in Japanese. Kogyo Kagaku Zasshi (J. Chem. Soc. Japan), 73(7):1731-1732, July 5, 1970. 3 refs.

Disposal of sulfur dioxide in pyrites roasting, petrochemical industry, or power plant waste gas is discussed. In a conventional wet disposal method, SO2 is merely neutralized by an agent like lime or ammonia, but a very large quantity of the neutralization agent is needed. Another disadvantage of the conventional method is that its sulfur oxide absorption efficiency drops with substances formed as a result of the neutralization process. When SO2 gas was made to flow countercurrent to manganese ore suspension in a tower, SO2 was reduced to sulfuric acid of a densit about the same as that obtained in a lead chamber method, and practically no SO2 was contained in the gas discharged from the tower. A 10% manganese-ore suspension was used in an experimental device in which the suspension was heated to the desired temperatures and, when vaporized by the heating, automatically reduced from gas to liquid. Ore composed of Mn(27.96%), SiO2(37.32%), Fe(8.16%) and P(0.03%) was pulverized to 80-mesh grains and mixed with water at a 10:90 ratio to make the suspension used as the absorbing agent. From the results of this test, it was determined that the higher temperature of the suspension, the higher its SO2 absorption efficiency; the amount of SO2 absorbed decreased with increasing sulfuric acid density in the suspension; at 50 C, the quantity of sulfuric acid contained in the suspension reached 74.3 g/100 ml. The contact time of SO2 gas with the suspension was 5.7 sec and the gas injection speed 8 cm/min. The device maintained about 100% SO2 absorption efficiency for 20 hrs, indicating that the manganese oxide suspension can be effectively used as an SO2 absorbing agent.

24675

Henke, William G.

THE NEW 'HOT' ELECTROSTATIC PRECIPITATOR. Combustion, 42(4): 50-53, Oct. 1970.

The problems associated with low-sulfur fuel are causing increased interest in the 'hot' electrostatic precipitator which, among its features, includes insensitivity to the sulfur content of the gases it cleans. By being located ahead of rather than downstream of the air heaters, the fly ash hot precipitator operates in the range of 500 to 700 F. However, the volume of gas at 600 F is nearly 40% greater than that of the same weight of gas at 300 F, and the higher cost of the hot precipitator is principally a matter of size. Low sulfur problems are caused by the fact that good electrostatic precipitator performance can only be obtained within a relatively narrow range of fly ash resistivity, roughly from 10 to the 8th power to 10 to the 10th power ohm-cm. Further details are considered of low sulfur problems, as well as problem solutions. One approach is enhancement of surface conductivity, but the more attractive alternative is to end dependence on surface conductivity with a high operating temperature. Oil ash is much more of a mobility problem whan fly ash, but at the temperature at which it leaves this hot precipitator, no problems have been encountered in hoppers or the conveying system. Six hot precipitator installations already operating on a pulverized coal boiler fly ash cover a variety of differing applications.

24678

Bartok, W., A. R. Crawford, and A. Skopp

CONTROL OF NITROGEN OXIDE EMISSIONS FROM STATIONARY COMBUSTION SOURCES. Combustion, 42(4):37-40, Oct. 1970. (Presented at the AICHE-IMIQ Joint Meeting, 3rd, Denver, Colo., Aug. 30-Sept. 2, 1970.)

Cost-effectiveness analyses of potential oxides of nitrogen control methods are presented for stationary combustion sources, and research and development needs in this area are critically evaluated. National Air Pollution Control Administration sponsered research related to stationary NOx control is discussed, including modeling of NO kinetics in combustion processes and the scrubbing of NOx from flue gases. The major factors known to influence the NOx emissions from combustion processes are the amount of excess air used for combustion, the heat release and removal rates, which define the temperature-time history of the combustion gases, transport effects, and fuel type and composition. Combustion flue gas treatment processes have been evaluated in the following general categories: catalytic decomposition of NOx, catalytic reduction of NOx, physical separation of NOx from the other components of the flue gas, adsorption of Nox by solids, and absorption of NOx by liquids. Aqueous absorption systems using alkaline solutions or sulfuric acid appear to offer the most promise for combined control of nitrogen and sulfur oxide emissions. In simple terms, cost effectiveness is defined as the ratio of the annual control cost to the tons of NOx removed. The estimated degree of NOx reduction and associated costs resulting from the application of potential control techniques are presented for a 1000 MW gas-fired, and a 1000 MW coal-fired power plant boiler. (Author abstract modified)

24681

Shepard, Donald S.

A LOAD SHIFTING MODEL FOR AIR POLLUTION CONTROL IN THE ELECTRIC POWER INDUSTRY. J. Air Pollution Control Assoc., 20(11):756-761, Nov. 1970. 9 refs.

Load-shifting, a relatively inexpensive approach to air pollution control, involves transferring the generating load from one power plant to another according to meteorological conditions. An atmospheric dispersion model is adapted to estimate the exposure of the urban population to sulfur dioxide from operating the power system in different ways. Then a mathematical model of the power system of a metropolitan area is constructed to determine the reduction in pollution exposure which could be achieved, and the costs involved. As a case study, the application of the model to St. Louis, Missouri, is simulated. Under favorable conditions, load shifting could reduce pollution exposure up to 95%, while increasing the costs of electric power generation by only 4%. The load-shifting model has use not only as an operational control strategy, but also as an analytical tool to evaluate alternative pollution control measures in the electric power industry. (Author abstract)

24697

Francis, W.

FLUE-GAS WASHING PROCESS. PART TWO. Power Works Eng., vol. 41:37-40, Feb. 1946. 4 refs. Part I. Ibid., vol. 41:17-21, 25, Jan. 1946. Part III. Ibid., vol. 41:75-77, March 1946. Part IV. Ibid., vol. 41:103-105, April 1946.

Comparison is made between two types of gas-washing systems and electrostatic precipitators, and technical features of the available non-by-product recovery processes are summarized. Both the effluent system, as developed at Battersea, and the non-effluen system, as developed from the Howden-I.C.I. pant at Fulham, have proven to be practical processes for any type of boiler plant fitted with induced or balanced draught fans. The additional cost of the gas-washing processes over the necessary cost of dust and grit removal by dry systems of equal efficiency is small. For this additional charge nearly all the harmful products of coal combustion are removed instead of less than 50%, as in the case of the most efficient electrostatic precipitators. It is suggested that the restrictions on the amount of sulfur oxides permitted in the exit gases from gas-washing plants should be relaxed to ensure greater freedom from operational difficulties. (Author conclusions modified)

24707

Bahno, Gosta

DESULFURIZATION OF FLUE GASES- THE PRESENT SITUATION. PART I. (Avsvavling av rokgaser- nuvarande lage I). Text in Swedish. VVS (J. Assoc. Heating, Ventilation, Sanit. Engrs.)(Stockholm), vol. 8:442-447, 1969. PART II. Ibid., vol. 9:489-497, 1969. 21 refs.

Available data on different American, German, and Japanese desulfurization methods show that for Sweden, with only two oil-fired power plants greater than 300 MW, flue gas cleaning would be too expensive and complicated. Some of the recovered products would become a serious waste problem. If regulations are adopted with a sulfur limit of about 0.5% or lower for fuels, then desulfurization methods seem to be realistic. The following processes are discussed: Mitsubishi-DAP-Mn, Hitachi activated coal (absorption), Kiyoura T.I.T. (ammonia), Showa Denko ammonia, alkalized alumina process, Dolomite injection wet process, Penelec process, Wellman-Lord process (Bechwell scrubbing), sulfacid process, Grillo process, Bischoff process, Dolomite injection dry process, Reinluft process, and Still process.

24756

Scheidel, C.

CHEMICAL ENGINEERING METHODS FOR REMOVING INORGANIC EMISSIONS. ACHEMA, Proceedings of a Symposium on the Disposal of Process Wastes, Liquids, Solids, Gases, Frankfurt au Main, West Germany, 1964, p. 177-186. Also: DECHEMA Monograph Ser., 52(895-911), 1964

Starting with known gas-purification processes (cyclones, scrubbers, filters, and electrostatic precipitators), a report is given on the current status of processes suitable for the precipitation of flue dust and inorganic solids in exit gases. Electrode design characteristics are compared, and the use of CS electrodes is shown to increase the collection efficiencies of electrostatic precipitators. Where electrostatic precipitators are impractical, excellent gas filtration is provided by a new gravel-bed filter. The gravel bed, which consists of quartz grains, is used in combination with a prefilter of metal or plastic wool. These filters are useful for temperatures up to 300 C and find application in mechanical processes such as the crushing, milling, and grinding of coals, ores, and minerals. Also described is the Reinluft activated coke process for removing sulfur oxides from waste gases. In this process, a moving bed of activated coke is conveyed downward in a tower housing an adsorber and a desorber section. Advantages of the process are that neither pretreatment nor dust removal is necessary and no liquids are involved. However, the residual gases rich in sulfur dioxide must still be converted to a solid or liquid sulfur compound. Activated coke is also used in the Sulfacid process for converting sulfur dioxide to sulfuric acid. In this process, the sulfuric acid formed by the adsorption of precooled and saturated gases in units packed with activated coke is washed out by spray nozzles mounted above the packing. To obtain a commercial grade of acid, any dust carried in the raw gases must be removed.

24777

(Inventor not given.)

PROCEDURE FOR RECOVERING ELEMENTAL SULFUR FROM SULFUROUS GASES. (Procede pour recuperer des gaz sulfureux le soufre elementaire). Text in French. (William Francis Lamoreaux) French Pat. 480,345. 6p., April 25, 1916. (Appl Nov. 29, 1915, 3 claims).

Sulfur oxides are reduced to elemental sulfur by maintaining contac between the sulfur oxide and incandescent coal for a predetermined period of time, supplying enough additional heat to insure practically complete reduction of the sulfur oxide during the perio of its contact with the coal. The equipment used for this procedure is designed in such a way as to utilize heat extracted from the gases emerging from the reduction chamber to supply at least part of the additional heat required for the process. Provision is also made to preheat the gases containing sulfur oxides before they enter the reduction chamber, using the heat derived from the gases from which sulfur has been extracted.

24785

(Inventor not given.)

IMPROVEMENT IN THE PROCESS OF PURIFYING FUMES AND GASES. (Perfectionnement a l'epuration des fumees et gaz). Text in French (Societe Anonyme, Weiritam (France)) French Pat. 1,482,873. 3p. April 24, 1967. (Appl. Feb. 12, 1966, 6 claims).

An aqueous solution of sulfur dioxide is obtained by condensation, on a cold wall, of water vapor contained in or added to the fumes or gases to be purified. The wall can be cooled by a heat exchange resulting from the circulation on the inner side of refrigerating fluids. In the case of fumes emitted by a heating plant, the heat recovered from this fluid can be transferred to a other point in the plant, where it can be used to supplement the heat production or to produce distilled water. When additional water vapor needs to be added to the fumes, this can be supplied in the form of a finely atomized water spray or in the form of steam. In the case of heating plants, after the removal of the aqueous condensation, the fumes can be reheated, possibly with the heat gained from the cooling process, so as to aid the dispersal of the exhaust gases when they reach the open air.

24826

Electric Energy Industry, Tokyo (Japan), Central Council of Electric Energy and Electric Energy Industry, Tokyo (Japan), Central Inst. of Research

PROBLEMS SET BY ATMOSPHERIC POLLUTION IN JAPAN. (Problemes poses par la pollution atmospherique au Japon). Text in French. Pollut. Atmos. (Paris), no. 47:163-168, July-Sept. 1970.

A discussion of problems concerning atmospheric pollution due to th electric industry is presented. The meteorological and geographical conditions which condition the action of atmospheric pollution in Japan are mentioned; the legal limits for sulfur dioxide are indicated, and the formulae for determining these limits are described. Action taken by power plants to prevent pollution includes research of appropriate sites for setting up plants; reduction of the sulfur content in fuels; adoption of high smoke stacks; dust collectors; and emergency measures to be applied in the event of unfavorable meteorological conditions. An outline of the present state of research and techniques concerning the fight against SO2 emissions is included.

24837

Wiedersum, G. C., Jr.

CONTROL OF POWER PLANT EMISSIONS. Chem. Eng. Progr., 66(11):49-54, Nov. 1970. 35 refs.

Changing boiler fuel from coal to oil (1% and 2% sulfur) does not automatically guarantee compliance with regulations and reduced operating problems. With oil, there is much less slagging on furnace walls and consequently greater difficulty in maintaining design steam temperature. Another difficulty due to reduced slagging is vibration of plates and pendent elements: clean tubes apparently permit the formation of Von Karman vortices in the gas stream while slagged tubes create enough turbulence to prevent it. In some cases, stack plumes are darker than before. This is the result of the light scattering properties of the finer oil ash particles and of lowered combustion efficiency that produces more unburned carbon in the flue gas. In addition, the ash is of a sticky nature and much more difficult to collect and transport. These problems may be alleviated following complete conversion to 1% sulfur oil. Supplies of such oil are limited, however, and chemical engineers and power engineers should consider alternate solutions to the air pollution problem. First and second-generatio sulfur-oxide removal processes are summarized and discussed. Also reviewed is the instrumentation available for monitoring stack emissions. Few, if any, of the instruments are suitable for long term tests under field conditions.

24881

Kazarinoff, Andrew

INDUSTRIAL AIR POLLUTION--ITS CONTROL AND COST. Design News, 23(14):18-24, July 5, 1968.

Power generating plants, steel mills, and cement kilns are included in the groups that will be forced by government restrictions to control pollutants. The industrial air pollution control equipment available now, the cost of pollution control to industry, and some air pollution problems for which there are yet no practical solutions are discussed. No real innovations have been made in control equipment for a long time; the major devices are still electrostatic precipitators, bag filters, cyclones, and scrubbers. Research and development is needed on equipment that can control both particulate and gaseous pollutants; equipment that can perform at higher efficiencies without size and cost penalties; equipment whose efficiency curve is relatively flat over broader ranges of particle size; and lower-cost equipment.

24922

LaMantia, Charles R. and Edwin L. Field

TACKLING THE PROBLEM OF NITROGEN OXIDES. Power, 113(4):63-66, April 1969. 9 refs.

The problem of atmospheric nitrogen oxides is analogous to that of sulfur dioxide in that fossil fuel-burning power plants are the main emission sources. However, the amount of SO2 generated per ton of fuel consumed is precisely fixed by the sulfur content of the fuel. The concentration of nitrogen oxides in stack gases depends primarily on temperature profile, gas residence time, and oxygen and nitrogen concentrations profiles in the furnace. All these factors are functions of furnace design and burner design and operation. The chemistry of nitrogen oxides affords the possibility of limiting their formation by modifying the combustion process or destroying them by catalytic decomposition. At stack-gas temperatures and nitrogen oxide concentrations, spontaneous decomposition should occur with the proper catalyst. These two approaches would solve the nitrogen oxides problem without significant complications, e.g., the need to build a nitric acid plant. A further approach, potentially attractive to operator who require SO2 control, is a single process effective for both SO2 and nitrogen oxides control. The least desirable solution woul be a separate process for removal of nitrogen oxides from stack gases.

24954

Combustion Power Co., Inc., Palo Alto, Calif.

COMBUSTION POWER UNIT -- 400: CPU-400. Bureau of Solid Waste Management Contract Ph 86-67-259, 15p., 1969. NTIS: PB 187299

Development has begun on a turbogenerator electric plant that will utilize 400 tons of municipal solid waste per day to produce up to 15,000 kw of electric power. The baseline configuration is a modular unit that is expected to be clean, compact, and quiet. Such units could be conveniently dispersed throughout a city to supplement power supplied by local utilities. The major components of the system are a refuse carousel, a mechanical shredder, a refus combustor using a fluidized bed reactor, a two-stage particle collector packed with the fluid bed reactor, a 15 megawatt gas turbine, and a 3600 rpm generator. Using either available energy or by-products from the combustion steam, add-on systems to the basic unit provide (1) automated vacuum collection of refuse, (2) fresh water produced from saline or brackish water, (3) centralized steam for commercial heating and air conditioning, and (4) incineration of sewage sludge. Estimated capital and operating costs of the plant are summarized, as is the expected income from electric power, steam, and by products. Costs for refuse disposal may be as little as 95 cents per ton.

24985

Dennis, Carl S.

POTENTIAL SOLUTIONS TO UTILITIES SO2 PROBLEMS IN THE '70'S. Combustion, 42(4):12-21, Oct. 1970. 2 refs. (Presented at Edison Electric Institute, System Planning Committee, Detroit, Mich., May 18, 1970.)

Standards emerging from Air Quality Control Regions indicate acceptance of the following values for ground-level sulfur dioxide concentrations: 0.50 ppm as a five-min average; 0.20 ppm as a one-hr average; 0.10 ppm as a 24-hr average; and 0.02 ppm as an annual average. At this point in time, the potential solutions to the utility industry's sulfur problems are low-sulfur fuel, tall-stack dispersion of slue gases, nuclear power, and SO2 removal systems. These solutions are evaluated with special attention to wet and dry SO2 removal systems considered to be commercially feasible. Wet systems discussed are Combustion Engineering's limestone scrubber system, Chemico-Basic's venturi scrubbing process, Babcock and Wilcox's scrubbing systems, and Universal Oil Products' limestone scrubbing process. Dry systems reviewed are Wellman-Lord's chemical absorption process, Atomic International's molten carbonate process, Monsanto's catalytic oxidation process, Babcock and Wilxox's fixed-bed sorbent reactor system, and the Stone and Webster-Ionics process. Costs for the four alternative solutions considered range from 7 cents/Mb for stack gas dispersion to 12.5 cents/mB for low-sulfur fuel substitution.

25019

Miura, Mitsugi

APPARATUS FOR TREATING A GAS TO REMOVE IMPURITIES THEREFROM. (Assignee not given.) U. S. Pat. 3,527,026. 5p., Sept. 8, 1970. 18 refs. (Appl. June 3, 1968, 4 claims).

A dry-method and a wet-method separator are employed to efficiently separate or recover fine particles and poisonous gases generated at a chemical plant, food plant, machinery plant, a iron works, or an electric power station. The present apparatus makes such treatment possible without lowering the temperature of the exhaust gas very much. In the past, when fine particles and poisonous gases contained in gaseous body were to be separated, a cyclone was used to separate a large part of the fine particles, while that portion of the particles which were not separated by the cyclone was sometimes separated by a bag filter, and electrostatic precipitator, or by a washing absorbing tower or venturi scrubber. The cost of installation was high, a large floor space was needed, and a waste water treating device was necessary. In the present process, a dry-method cyclone and a wet-method separator are combined into one unit. The cyclone is provided with spray means in the gas discharge pipe, and includes a hopper spaced from the wall of the cyclone filled with liquid. Solid substances contained in the gas are separated in the inner wall of an outer cylinder by centrifugal force, while the very fine particles come into contact with the water or solution contained in the liquid tank. A liquid surface controlling meter is used for feeding spray to keep the surface constantly at the same level.

25038

Gartrell, Francis E. and James C. Barber

ENVIRONMENTAL PROTECTION--TVA EXPERIENCE. J. Sanit. Eng., Am. Soc. Civil Engrs. Div., 96(6):1321-1334, Dec. 1970. 7 refs. (Presented at the American Society Civil Engineers, Water Resources Engineering Meeting, Memphis, Jan. 26-30, 1970.)

Establishment of the Tennessee Valley Authority created a unified program that saw in the Tennessee Valley's water, land, minerals, and forests one interrelated set of opportunities for improving the living standards of the people in the region. Research on soil-fertilizer relationships, fertilizers, and fertilizer processes is conducted at the National Fertilizer Development Center. One water resource study which was undertaken at the Center involved determination of the conditions that give rise to excessive growth of nuisance weeds in a TVA reservoir, while another project involved determination of the amount of plant nutrients lost from land into both surface and ground waters. Two approaches may be followed in the development of fertilizers for the control of nutrient losses in streams; slow-release chemica compounds may be used as fertilizers, or the highly soluble fertilizer granules may be coated to retard their solubility in the soil. Various fertilizers are produced at the Center, and environmental control during their production is discussed. Electric furnace phosphoric acid production presents some particularly difficult pollution abatement problems. Production of fluoride by-products may be economical in some large electric furnace phosphoric acid plants or in plants where large amounts of fluorine are driven off during the phosphate ore heat hardening step. A modern ammonia plant is being constructed. Two of the 11 coal-fired power plants in the TVA system have cyclone furnaces, eight have dry bottom pulverized fuel furnaces, and one has a wet bottom pulverized fuel furnace. They all have essentially the same system for ash disposal. Research is being conducted on the remova of sulfur dioxide from power plant stack gases, including an ammoni scrubbing process, sorption by dry limestone, and limestone wet scrubbing. Waste heat for disposal has required a study of the effects of cooling tower discharge. Also, composting research is being conducted adjacent to the city's sewage treatment plant.

25047

Walker, A. B. and R. F. Brown

STATISTICS ON UTILIZATION, PERFORMANCE AND ECONOMICS OF ELECTROSTATIC PRECIPITATORS FOR CONTROL OF PARTICULATE AIR POLLUTION. Preprint, International Union of Air Pollution Prevention Associations, 28p., 1970. 8 refs. (Presented at the International Clean Air Congress 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-22C.)

Selection of an optimum control strategy requires accurate cost-benefit information specific to individual sources. As part of an overall system study on particulate emission control with electrostatic precipitators, and exhaustive compilation of performance and economic data on precipitators for specific applications is presented. Eight application areas are covered, including: electric utility industry; pulp and paper industry; iron and steel industry; rock products industry; chemical process industry; mining and metallurgical industry; petroleum industry; and miscellaneous. Performance, capital cost, operating cost, annualized cost according to age of installation, and cost factors as related to process output are presented. Information presented should prove useful to those examining alternative strategies for control of particulate emissions using either simulation model or maximum use of state-of-the-art approaches. (Author abstract modified)

25071

Tamarua, Zensuke

DESULFURIZATION METHOD FROM STACK GAS BY ACTIVATED CARBON. Preprint, International Union of Air Pollution Prevention Associations, 25p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-35D.)

The activated carbon process for desulfurization stack gas derives from the principle that the adsorption of sulfur dioxide by carbon is both physical and chemical. The process comprises adsorption of SO2, oxidation of SO2, hydration of SO3, and dilution of the sulfuric acid formed on the carbon. Five activated carbon towers are used, four for adsorption and one for desorption. The towers can be operated continuously while the activated carbon is being regenerated by washing with water. Several washing tanks are provided according to acid concentrations A complete cycle of drying, adsorption, washing, and regeneration is 60 hours. Tests of the process in a 55 mW pilot power plant showed that SO2 removal declined with time in the first 1500 hours of operation, after which it became 80% of initial capacity. The constant removal rate after 1500 hours suggests that the life of carbon is long. It is necessary, however, to cool the carbon bed by forced air flow. The 20% sulfuric acid obtained by the process is condensed to 65% sulfuric acid for use in phosphatic fertilizer. Based on the pilot plant experience, a 1500 nW semicommercial plant is to be built.

25079

Humbert, Clyde O.

METHOD FOR ELECTROSTATIC PRECIPITATION OF DUST PARTICLES. (Koppers Co., Inc., Monroeville, Pa.) U. S. Pat. 3,523,407. 4p., Aug. 11, 1970. 8 refs. (Appl. March 29, 1968, 6 claims).

Electrostatic removal of particles that are entrained in a gas stream can be improved by the addition of preselected amounts of ammonia and water into the particle-laden gas stream where the gas is at an elevated temperature. Optimum precipitation occurs when ammonia is added in an amount of from 10 to 20 ppm of gas, if water is added in an amount of from 4-8 gallons per 100,000 cu ft of gas, and the gas temperature is above 400 F. The ammonia and water added to the gas stream are believed to react with the sulfur trioxide to form an ammonium bisulfate film which envelops the particles. Ordinarily, fly-ash particles from a power plant, for example, include a minor amount of SO3. It appears that a synergistic relationship exists to explain the improved collection efficiency.

25088

Nagai, Hirokazu

DESULFURIZING APPARATUS FOR COMBUSTION GASES. (Nensho haigasu datsuryu sochi). Text in Japanese. (Tokyo Shibaura Electric Co., Ltd., Kanagawa Prefecture (Japan) Japan. Pat. Sho 45-12481. 3p., May 7, 1970. (Appl. March 31, 1966, claims not given).

Sulfur dioxide in the flue gas can be eliminated by passing it through a layer of catalysts such as vanadium pentoxide and oxidizing the sulfur dioxide. The invention deals with the removal of sulfur dioxide by the above method, especially the facilities that are used to cool the gas after it has gone through the catalyst layer to form the sulfuric acid mist by condensation. The condenser has to be acid proof, and a material that is acid proof as well as economical is polytetrafluoroethylene. Its heat conductivity range is almost adiabatic, and its other physical characteristics make it necessary for the cooling pipes to be small in diameter and thin walled. When this condenser is attached to the heat cycle of the steam generating plant in order to utilize the heat effectively, the employment of turbine recycling water would impose pressure on the polytetrafluoroethylene pipe of the cooler. The thinness of the pipe would ordinarily not permit the pipe to sustain the pressure, but the difficulty can be overcome by the combination of a low-pressure recycling pump and a high- pressure recycling pump in front of and at the end of the condensation system. The pipes can thus be protected from high pressure. A detailed diagrammatic explanation is given.

25127

Busby, H. G. T., C. Whitehead, and K. Darby

HIGH EFFICIENCY PRECIPITATOR PERFORMANCE ON MODERN POWER STATIONS FIRING FUEL OIL AND LOW SULPHUR COALS. Preprint, International Union of Air Pollution Prevention Associations, 56p., 1970. 4 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., 1970, Paper EN-34H.)

The problems associated with electrostatic precipitators operating on a low sulfur bituminous coals and on oil fired burners are discussed, and various methods of insuring that particulate emission is reduced to the required level are described. In the case of bituminous coals the performance of an electrostatic precipitator is dependent on the resistivity of the dust which, at temperatures following the air heater outlet, is primarily determined by the surface layer conditions. This surface layer which is probably sulfuric acid vapor is formed from the combustible sulfur in the coal and there is normally a relationship between combustible sulfur in coal and precipitator performance. Where low sulfur coal is fired and precipitator difficulties are encountered, high efficiencies can still be achieved at the cost of high capital expense as the precipitators may need to be several times the size of those required for high sulfur coal, or alternatively, the resistivity of the dust can be reduced by varying temperature or by changing the nature of the surface layer of the dust. Of the methods discussed, changing the surface layer offers the best solution. This method can be applied readily to existing precipitators without down time. Of the various conditioning agents which can be used to alter the surface layer of the dust, in the case of a single installation, sulfur trioxide in liquid stabilized form provides the most convenient means of producing sulfur trioxide gas, whereas, if a large base load station is to be equipped then the sulfur burner with catalytic converter is the more economical in operating costs. Precipitators can be used satisfactorily on oil fired boilers provided care is taken in purging the insulators, rapping rates are kept low and suitable dedusting employed. The chief advantage of precipitation is during start-up periods when the formation of acid smut conditions are most severe. While they are considered an essential in the vicinity of a built up area, there is still some doubt as to whether, in other districts, the capital cost of a precipitator on an oil fired installation can be fully justified. The use of high or low sulfur fuels has little effect on precipitator performance and the emission of sulfur dioxide and possible acid smut formation is only a matter of degree. (Author conclusions modified)

25139

Eisner, Joachim H.

THE APPLICATIONS OF MODERN ELECTRIC GAS PURIFICATION INSTALLATIONS. (Einsatzmoeglichkeiten moderner elektrischer Gasreinigungsanlagen). Text in German. Wasser Luft Betrieb, 14(10):394-402, Oct. 1970.

Electrofilters will separate up to 99.9% fine and finest suspended particles, handle large quantities of gases at temperatures up to 600 C. Electrofilters usually work with a voltage of 78,000 V, electricity consumption is minimal. In dry electrofilters the dust is removed from electrodes by rapping. Under adverse conditions the gas to be purified can be conditioned by evaporative cooling by reducing gas temperature and by raising the dew point. In some cases this pretreatment is essential. In wet electrofilters the premoistened dust together with water droplets in the gas and the injected water fog are separated on the collecting electrodes in the form of a water sludge. The possibilities of technically and commercially advantageous application of electrofilters in steel and iron works ore sintering plants, blast furnaces, steel production), in nonferrous metal smelting plants, in iron foundries, shaft furnaces, sintering grate band, disintegrators, dryers), in ceramic works, in coal processing (generator gas, coke-oven gas, other gases), in steam power plants and in chemical and related industries (plastics, cellulose, sulfuric acid, regeneration of hydrochloric acid in tanneries) are reviewed.

25164

Barrett, A. A. and G. W. Brier

GAS CLEANING IN CEGB POWER STATIONS. Preprint, International Union of Air Pollution Prevention Associations, 39p., 1970. 4 refs (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-34E.)

A brief outline of the legislation regulating the permissible discharges from power station chimneys in the United Kingdom is given as well as information on the design of chimneys. Mention is made of the problems associated with gas cleaning on a stoker-fired, pulverized coal-fired and oil-fired plant. Emphasis is placed upon the need for good maintenance. Methods of testing and monitoring chimney emissions are given with mention of instruments specially developed by the Central Electricity Generating Board. A section is devoted to the arrangement of a large electrostatic precipitator and goes into some detail of the design of the collecting electrodes, discharge electrodes, methods of rapping, dust hoppers, and control of high-tension sets. Results are included of research work on the effectiveness of rapping and the means of measuring it, the reasons for the failure of discharge electrodes, the advantages of sectionalization, methods of obtaining good gas distribution, and work done on gas conditioning with various additives. The basis of precipitator design is the effective migration velocity of the dust; once a suitable figure is established there is no difficulty in designing a satisfactory plant. Although the variables which affect the migration velocity are well known, the actual extent of their influence is difficult to determine. An analysis of the results from 109 sets of test data from 23 different power stations has been carried out. This has facilitated the creation of a number of curves, one for each significant variable, which can be used to predict the effective migration velocity for any combination of conditions. Reasonable agreement has been shown between the test results and the calculated figures. The method can be used to study the performance potential of an installed plant or to facilitate the design of a new plant. It is also possible to correct results for research work in order that conclusions can be evaluated on the same basis. (Author abstract)

25165

Harrison, D. and A. Saleem

WHERE WE STAND IN SULPHUR DIOXIDE CONTROL. Mod. Power Eng., 64(6):62-63, June 1970.

A large amount of research and development work is being done in laboratories throughout the work to develop sulfur dioxide control systems for thermal power stations. Formidable technical difficulties to be overcome are related to the large volume of gases to be treated, interference with process chemistry from constituents such as oxygen and fly ash, scale up of the equipment to required size, and disposal or marketing of the sulfur dioxide recovered. Processes under study by an Ontario plant are the dry limestone injection process, a limestone slurry scrubbing process, an alkaline sulfite/bisulfite process, an ammonia process, and the catalytic oxidation of sulfur to hydrogen sulfide.

25170

Jarman, R. T.

THE POWER STATION AND THE ENVIRONMENT. J. Soc. Eng. London, 61(3):219-232, July-Sept. 1970. 21 refs.

Following a brief outline of power plant operation, the effects of fossil-fueled power stations on their environment are considered. The main effects related to flue emission and cooling water supplies. The close control of flue gas emission is necessary to maintain clean air in the neighborhood. It is achieved by proper design of burners and proper attention to combustion conditions, by collection of fine ash particles in electrostatic precipitators, and by dispersion of the gases from tall chimneys. Pulverized fly ash (PFA) removed from the flue gas can be used for reclaiming land and in the manufacture of certain varieties of concrete blocks and related materials. Cooling water systems are designed to avoid harming the local aquatic life, and are subsequently investigated to test the effectiveness of these precautions in practice. A recent development is the experimental study of fish farming, which may well lead to the profitable utilization of the warm water produced by power stations. The practices discussed are illustrated by the example of several British power plants. (Author abstract modified)

25184

Knapp, Edward M. and Weldon T. Ellis

METHOD OF SEPARATING GASEOUS HYDROCARBONS. (Assignee not given.) U. S. Pat. 3,523,405. 14p., Aug. 11, 1970. 3 refs. (Appl. June 2 1969, 1 claim).

A method is described for refining a stream of gaseous fluid containing commercially valuable chemicals (low boiling complex hydrocarbons) along with other chemicals in two stages. In the first stage, the portions of coal that vaporize below 800 F are separated into those that vaporize below 525 F and a residue consisting of the higher boiling constituents. Fractional distillation in 5.4 F increments condenses out the saleable hydrocarbons from the below 525 F cut. The process is unique in that the temperature of the coal from which the gaseous input to the system is obtained is never allowed to exceed 800 F, thus preventing the destruction of many of the hydrocarbons that, in normal destructive distillation, are lost. The method of the first stage consists of passing the entire stream of gas through a moving oil bath to accomplish the total absorption of the gas, and subsequently obtaining the partial desorption from the bath of those chemicals having boiling points lower than 525 F; the chemicals having boiling points higher than 525 F are retained in the oil and collected. The method of the second stage consists of differential fractional condensation from the resultant gas of a number of differential fractions. This is accomplished by passing the gas stream over first one and then another of a series of rotating condensing surfaces; each surface is maintained at a specific temperature sufficient to cause the chemicals which condense at that temperature to condense.

25186

Krug, Herbert and Werner Feiler

PELLETIZING OF FINE COKE WITH TARRY ADHESIVES FOR THE PRODUCTION OF SMOKELESS FUEL. (Das Pelletieren von Feinkoks mit teerartigen Bindemitteln-ein Beitrag zur Herstellung raucharmer Brennstoffe). Text in German. Bergbautechnik, 20(9):474-477, Sept. 1970. 4 refs.

In contrast to anthracite coal dust which can be satisfactorily pelletized with water, bentonite and sulfite liquor adhesion of coke dust particles can be produced only with an adhesive as is the case in briquetting with the adhesive turned into coke by thermal treatment of the green pellets forming bridges among the coke particles. The requirements on pellets are that they be at least 20 mm in diameter, that the green pellets be strong enough to stand the transport to the thermal treatment chamber, that the yiel of pellets be as nearly theoretical as possible and that they exhibit rigidity during coking. Pelletizing experiments were performed with Lurgi's low-temperature coke, with anthracite coke and with BHT coke of a grain size not exceeding 0.5 mm and of 12% humidity. Brown coal low temperature tar, crude anthracite tar and BHT tar were used as adhesives. Best suited as adhesive turned out to be a mixture of BHT tar with raw anthracite tar in a 3:2 ratio which yielded pellets up to 40 mm in size of good adhesive properties already at 150 C. The process was further improved by a second pelletizing without the addition of adhesive but only of coke which reduced the share of the adhesive to 21% and increased the size and strength of the pellets. Some of the adhesive used is recovered from the process in the form of water free heating oil.

25187

Simon, Conrad and Edward F. Ferrand

THE IMPACT OF LOW SULFUR FUEL ON AIR QUALITY IN NEW YORK CITY. Preprint, International Union of Air Pollution Prevention Associations, 55p., 1970. 5 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-12F.)

The conditions that led to the adoption of regulations restricting the sulfur content of fuels burned in the New York Metropolitan area are discussed, and the initial impact of these actions is presented. An attempt is made to highlight the importance of source-receptor relationships and the varying influence of meteorological parameters over different sections of the area. Sulfur dioxide data from three stations of the nine station network existing prior to 1969 were used to evaluate the impact of early reductions which occurred primarily in power plant emissions. Subsequently, data from the city's expanded 38-station aerometric network were examined to determine the various changes in sulfur dioxide concentrations across the city. Analysis clearly showed that the stations observed degrees of change in concentrations of SO2 which differed depending on their location relative to space heating and power plant sources. It was particularly noteworthy to fine that reductions in SO2 concentrations were greater for peak hourly values than for daily or seasonal means. It was determined that within the central city, where the overwhelming majority of space heating requirements are met by residual fuel oil, a greater than 20% decrease in concentrations had occurred during the 1969-70 heating season. However, a greater than 20% increase in sulfur dioxide concentrations occurred in the fringe areas of the City. This increase in the fringe areas is attributed to differences in climatological conditions between the two heating seasons. On the basis of this, it can be deduced that a potential 40% improvement occurred in the central city as a result of the use of low sulfur fuel oil for space heating. (Author abstract)

25207

Pottinger, J. F.

THE COLLECTION OF HIGH RESISTIVITY MATERIALS BY ELECTROSTATIC PRECIPITATION. Preprint, International Union of Air Pollution Prevention Associations, 30p., 1970. 8 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-34G.)

The chemical composition and refractory nature of the ash derived from the firing of Australian coals usually result in fly ash particles of extremely fine size with high electrical resistivities Significant reduction in electrostatic precipitator efficiency can occur when handling these materials at 100-200 C. Actual performance levels, however, can differ widely from one installation to the next even when dusts possess generally similar properties. An efficient rapping system is an essential requirement in the treatment of high-resistivity materials. Optimum distribution of corona current is also important: electrode design voltage waveform, and high-tension sectionalizatio are important factors determining the current distribution pattern. Where resistivity problems are severe, some form of gas conditionin is required to change the dust or gas characteristics sufficiently to eliminate the effects of back-ionization. Typical effects of conditioning agents such as moisture, sulfur trioxide, and ammonia are outlined. Where resistivity is likely to influence precipitator efficiency, pilot-scale investigations should be carried out to determine optimum design parameters, since measured values of electrical resistivity are not an infallible guide to precipitator performance.

25217

Strembitskiy, An. N. and V. A. Pavlunin

TEST OF AN ASH TRAPPING INSTALLATION WITH ELECTROSTATIC FILTERS DVPN-3x2OBTs. (Istpytaniye zoloulavlivayushey ustanovki s elektrofil'trami DVPN-3x20 BTs). Text in Russian. Elektr. St. (Moscow), 41(8):63-64, Aug. 1970.

A gas trapping installation utilizing two vertical DVPN-3x20BTs electrofilters was tested at an electropower station which burns a variety of coals. This installation was designed to provide 98% dust removal (initial dust content, 39 g/cu m; final dust content, 0.78 g/cu m) with a gas flow of 118 cu m/sec at 140 C, and a hydraulic resistance of 80 mm H2O. Under actual operation, this installation provided 92.1-93.9% dust removal and consumed 0.94-1.24 kWhr of power per 1000 cu m of gas processed, with a specific current of 0.072-0.101 mA per meter of discharge conductor.

25269

Krug, Herbert, Werner Feiler and Dieter Schoenherr

PELLETIZING OF BROWN COAL ELECTROFILTER DUST. (Untersuchungen zum pelletieren von Braunkohlen-Elektrofilterstaub). Text in German. Bergbautechnik, 20(9):478-481, Sept. 1970. 7 refs.

Since brown coal dust from electrical dust separators caused processing difficulties when used for briquetting, pelletizing was attempted with the view of producing an as far as possible smokeless fuel. When water, bentonite and sulfite liquor were used, the strength of the pellets was too low; the relatively loose agglomerates disintegrated in heat. Tarry adhesives had to be used. It was found that the alternating addition of adhesives had to be used. It was found that the alternating addition of adhesives and of dust to the pelletizing process resulted in a 100% yield while with simultaneous addition of both components the yield was always lower. A 40% addition of the tarry adhesive is required to bind all dust particle sizes into pellets. A 38 degree incline of the pelleting table yielded the greatest share of pellets exceeding 25 mm in diameter at 38 C. A comparison of the properties of pellets made with low temperature tar, with pitch residue, with BHT tar and with anthracite coal tar disclosed that pellets made with low temperature anthracite coal tar manifested better coking characteristics. The other characteristics like ash content, content of water and of volatile substances were comparable. The commercial feasibility of this process will depend on economic considerations.

25284

Kiyoura, Raisaku and Milton Munidasa

AVAILABLE DESULFURIZATION TECHNOLOGY AND ITS APPLICATION TO THE RATIONAL UTILIZATION OF FOSSIL FUEL. Preprint, International Union of Air Pollution Prevention Associations, 29p., 1970. 27 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-29D.)

Japan's energy commission has just released its projections of energy patterns for the next 15 years and the forecast for 1985 is almost 4.9 times the actual consumption in 1968. Almost 72% of these requirements are to be met by fossil fuels. Japan, by virtue of her commitments and investments is obliged to utilize fuel oil from the Middle East, known to contain almost 3% of sulfur; this sulfur would be subsequently spewn into the atmosphere as sulfur oxides. The stringent standards set by Cabinet decision of 1969 viz: 'the hourly value of 0.1 ppm or less shall be maintained for more than 88 per cent of the total hours within a year; and the 24 hour average value of 0.05 ppm or less shall be maintained for more than 70 per cent of the total days within a year,' presents a pressing need for highly efficient processes that are technically and economically feasible for the industrialist to bring about the control of air pollution. Three possible methods for sulfur dioxide control are envisaged: desulfurization of fossil fuels, removal of sulfur dioxides from flue gases, and changing technology of power generation, switching from high sulfur fuels to low sulfur fuels, sulfur free natural gas, or to a complete new change of power generation technology. The last would take some time before any concrete answer can be given; the demand for low sulfur fuel outstrips the supply; fuel oil desulfurization in spite of available technology results in a rather expensive product. A general evaluation of flue gas removal processes which have reached advanced pilot plant studies for technical feasibility and process applicability is presented, with a review of the present status of development. (Author abstract)

25298

Peranio, Anthony

THE TALL STACK - TECHNICAL AND SOCIAL ASPECTS. Preprint, International Union of Air Pollution Prevention Associations, 73p., 1970. 58 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., 1970, Paper ME-8F.)

The use of a tall stack for the discharge of pollutants at sufficiently high levels so as to lessen concentrations at the ground is considered. The tall stack in itself does not reduce the total amount of pollutants discharged into the atmosphere, and, under certain relatively frequent critical weather conditions, fumigations are obtained notwithstanding the tall stack. When total pollutant burdens in a given geographical region reach undesirable levels, the addition of new sources of pollution-even if they discharge through tall stacks- is unwarranted. Dispersion means are not effective in an already over-burdened environment. Most regions have overdone the technique of discharging into the environment. The pressure on pollution control technologists today is to produce efficient and inexpensive collection and (ideally) conversion devices for wastes. A typical mis-application of the tall stack is treated, that of a 150 meter (492 ft) chimney servicing a 528 MW electric power station in Tel Aviv, Israel. To justify construction of this strong source of pollution in the heart of the Tel Aviv megalopolis, several experts were required. Each of the five expert opinions varied considerably since each used different parameters for computations. The work on which the 150 meter computation was based was shown to contain several serious errors. An attempt to stop the electric company by obtaining a court injunction was unsuccessful. A group of four citizens (assisted by the Public Council for the Prevention of Noise and Air Pollution) attempted to 'prove' future damage to health and property. It was hindered by the lack of a definite emission standard for sulfur dioxide. The present Israel sulfur dioxide regulation is a proposed air quality standard and lacks legal force. An attempt is made to explain the economic and political forces which act to thwart the promulgation of emission standards. To this end, use is made of 'Gresham's Economic Law Applied to Pollution.' (Author abstract modified)

25320

Diakonoff, Serge

PROCESS FOR RECOVERING SULFUR FROM GASES CONTAINING SULFUR DIOXIDE. (Procede de recuperation du soufre, des gaz contenant d l'anhydride sulfureux). Text in French. (International Mining Trust Registered (Liechtenstein)) French Pat. 775,910. 2p., Oct. 22, 1934. (Appl. Oct. 5, 1933, 5 claims).

Sulfur dioxide is converted into hydrogen sulfide by reducing it with carbon in the presence of water vapor, then causing the H2S to react with sulfur dioxide to form sulfur and water. The sulfur dioxide is separated from the gases containing it by the use of a solvent such as cold water. The solution is then heated to drive off the SO2 gas, which is mixed with a quantity of water vapor and brought into a coal furnace heated to 500-850 C. The gases leaving the furnace are brought into a tower, where they come in contact with a solution of SO2, and the gas mixture containing SO2 is absorbed in the scrubbers; the solution thus obtained is recycled.

25323

(Inventor not given.)

PROCESS FOR CONTINUOUSLY RECOVERING SULFUR FROM HOT GASES CONTAINING DUST. (Procede de recuperation du soufre contenu dans des gaz chauds renfermant des poussieres). Text in French. (Imperial Chemical Industries, Ltd., London (England)) French Pat. 717,934. 3p., Oct. 26, 1931. (Appl. May 29, 1931, 2 claims).

The dust content of the gas is regulated in such a way that a relatively small number of centers of condensation are made available, after which the gas is submitted to a slow cooling process. The resulting large particles of sulfur are easily separated by filtration or by precipitation. The dust content of the gas is regulated by adding a certain portion of the original gas containing the dust to a relatively large volume of the same gas, from which most of the dust particles have been removed. The gas is extracted by reducing diluted sulfur dioxide gas with coal at a high temperature.

25416

Lowell, Philip S., Delbert M. Ottmers, Jr., Klaus Schwitzgebel, Thomas I. Strange, and David W. DeBerry

A THEORETICAL DESCRIPTION OF THE LIMESTONE INJECTION-WET SCRUBBING PROCESS. (FINAL REPORT). VOLUME I. Radian Corp., Austin, Tex., Contract CPA-22-69-138, 160p., June 9, 1970. 100 refs. NTIS: PB 193029

A basis for a theoretical description of the limestone injection-wet scrubbing process for removal of sulfur dioxide from power plant flue gases is given. A literature survey yielded the pertinent chemical data for the aqueous system. A computer program to calculate the partial pressures of SO2 and carbon dioxide above aqueous solutions containing calcium, magnesium, sodium, nitrate, sulfate, and chloride ions, and CO2 and SO2 was written and checked against experimental data. Turbulent contact absorbers and marble bed absorbers were described mathematically. Thermodynamic data for the dissociation constants of calcium sulfite and magnesium sulfite and the solubility product constant for hydrated calcium sulfite were determined experimentally. Sulfur dioxide sorption systems were simulated that approximate the process used at Kansas Power and Light and the process to be used in the NAPCA prototype system at TVA's Shawnee Power Plant. Flow rates, stream compositions, and important process variables are given. (Author abstract modified)

25427

Scaiola, Gianni

ESTIMATION OF THE INVESTMENTS AND EXPENDITURES NECESSARY FOR THE ELIMINATION OF POLLUTION. (Stima degli investimenti e dei costi necessari per l'eliminazione dell'inquinamento). Text in Italian. In: L'Intervento Pubblico Contro l'Inquinamento: Rapporto di Sintesi, p. 107-136, June 1970. 9 refs.

The investment, maintenance, and operating costs involved in the elimination of the more important forms of air and water pollution are estimated with reference to automotive emissions (hydrocarbons, carbon monoxide, and nitrogen oxides), industrial emissions (particulate pollution, sulfur dioxide, nitrogen oxides, hydrocarbons, and fluorine compounds), electric power plants, domestic heating (with a table of central heating plants and corresponding population figures for eleven Italian cities), liquid effluents from industrial and private sources, and the marine transport of petroleum and petroleum products. For each category, the procedure is described by which the estimates are made.

25430

(Inventor not given.)

PROCESS FOR OBTAINING SULFUR FROM SULFUR DIOXIDE, COAL, AND CALCIUM SULFATE. (Verfahren zur Gewinnung von Schwefel aus Schwefeldioxyde, Kohle and Gips). Text in German. (Actien- Gesellschaft fuer Anilin-Fabrikation, Berlin, (West Germany)) Ger. Pat. 300715. 2p., Jan. 2, 1920. (Appl. Nov. 4, 1916, 1 claim).

A process is described for the reduction of sulfur dioxide to elemental sulfur. A temperature favorable to an optimum reaction is created inside a reaction chamber by burning coal with oxygen. This enables the generation of heat for the process from within the reaction chamber, by the combustion of the coal, and eliminates a two-stage process required by earlier inventions. This makes possible a simpler construction for the furnace.

25494

Jara, Vladimir, Jan Bettelheim, and Jaroslav Skrivanek

THE REGENERATION OF THE ABSORPTION SOLUTION FROM THE ABSORPTION OF SO2 FROM INDUSTRIAL WASTE GASES. (Zpusob regenerace absorpcniho roztoky pri zachycovani kyslicniku siciteho z prumyslovych odpadnich plynu). Text in Czech. (Czechoslovak Republic) Czech. Pat. 106,240. 2p., Jan. 15, 1963. (Appl. Sept. 12, 1961, 3 claims).

Sulfur dioxide contained in flue gases from industrial furnaces is washed in absorbers by a solution of sodium hydrogen sulfite wit the necessary sodium ions being supplied in the form of 8-20% by weight sodium carbonate whose concentration must, depending on temperature and humidity of the gas, be so chosen that the concentration of the resulting sodium hydrogen sulfite fluctuate between 40 and 47% by weight. The liberated carbon dioxide escapes with the desulfurized gas while the resulting sodium hydrogen sulfite solution is led to a reactor where it is decomposed by sulfuric acid. The decomposition yields concentrated SO2 which is dried and liquefied or converted to sulfuric acid and sodium sulfate. The sulfuric acid is used for the decomposition of NaHSO3. Following neutralization with sodium carbonate and evaporation, the sodium sulfate solution (20-33% by weight) is reduced to sodium sulfide by coal or coke in a furnace at 600-1100 C with the simultaneous liberation of CO2. The Na2S is converted by CO2 to soda and H2S. The filtered soda solution is used for the absorption of SO2. Sulfur is oxidized to SO2 which is further processed with the gaseous SO2 from the decomposition of Na HS03.

25503

McCrea, D. H., J. G. Myers, and A. J. Forney

EVALUATION OF SOLID ABSORBENTS FOR SULFUR OXIDES REMOVAL FROM STACK GASES. Preprint, International Union of Air Pollution Prevention Associations, 35p., 1970. 9 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-35A.)

Absorbents for the removal of sulfur dioxide from stack gases have been widely studied. A description is given of two dry, regenerable absorbents, copper oxide impregnated into an alumina support and sodium carbonate obtained by thermal decomposition of Trona ore. Preliminary process designs and economic evaluations for power-plant utilization are included. Copper oxide readily reacts with the SO2 in flue gas at temperatures between 300 and 450 C. It can be regenerated using methane at a temperature as low as 400 C, and it remains physically and chemically stable after long use. In the conceptual process, SO2 removal occurs at 430 C in a fluidized reactor where the pellets are contained for about 40 minutes. The absorbent is then regenerated at about the same temperature, in a gravitating bed, and the SO2 evolved is converted to concentrated sulfuric acid. Cost of the process, before by product credit, is estimated at 1.26 mills per kilowatt hour of power produced. Sodium carbonate reacts very rapidly with SO2 at temperatures between 200 and 400 C. It can be regenerated by reduction at 700 to 750 C followed by carbonation at 400 to 500 C. While it is physically inferior to impregnated copper oxide, this is offset by its lower cost. In a power plant, SO2 can be removed at 300 C in a conveyed solids contactor and the absorbent regenerated with reformed methane in a two-stage pressurized reactor. The hydrogen sulfide evolved during regeneration is converted to elemental sulfur. Cost, before byproduct credit, is estimated as 1.35 mills per kilowatt hour. The estimates show that absorbent properties are but one of the factors that influence operating cost. Further absorbent development is unlikely to reduce the cost of SO2 removal below about one mill per kilowatt hour. However, the high equipment costs suggest that significant reductions might be achieved by modification of gas-solid contactors and better integration of SO2 removal with power-plant operations. (Author abstract modified)

25517

Reid, William T.

WHAT ABOUT AIR POLLUTION BY POWER PLANTS. Battelle Res. Outlook, 2(3):21-24, 1970.

While annual pollutant emissions from power plants are one-fourth those of automobiles and trucks, the amount of pollutants released during peak periods is a real cause of concern. The major pollutants are sulfur oxides, nitrogen oxides, and particulate matter. Major schemes under study for controlling sulfur oxides are scrubbing with water; scrubbing with carbonates such as lithium, sodium, and potassium; limestone injection; conversion of SO2 to SO3 in a fixed catalyst bed; and the alkalized alumina process. Engineering problems remain to be solved in every case. The low cost and almost universal availability of limestone make it a preferred reactant for SO2, but the quantities required create handling and disposal difficulties. Systems based on recovering sulfur are not appealing now because of the low cost of sulfur. For reducing nitrogen oxides emissions, only burning at a maximum temperature that is as low as possible is feasible for large boiler furnaces. Flame temperature can be held down in two practical ways: (1) admitting part of the air into the burner region prior to combustion, then supplying the rest of the air afte combustion or (2) recirculating appreciable amounts of flue gas into the flame region. Both schemes are adaptable to gas-fired and oil-fired boiler furnaces but pose engineering problems when pulverized coal is burned. Fly ash can be satisfactorily removed from flue gas by inertial collectors and electrostatic precipitators. The major aim now is to do it more completely at acceptable cost.

25529

Cambel, Ali B.

IMPACT OF ENERGY DEMANDS. Phys. Today, 23(12):38-43, 45, Dec. 1970. 9 refs.

Power production is undoubtedly the main source of the degradation of the environment. Yet the solution is not in forbidding the growth of the energy industries, because it is the availability of cheap and abundant energy that makes an improved standard of living possible. New counter-technologies that better exploit the potentialities of the laws of thermodynamics and electrodynamics are needed. The government can provide subsidies or tax write-offs for energy-development research as it did for the aerospace and electronics industries, and encourage competitions among different fuels and energy converters. One competition would be created by the development of household hydrocarbon fuel cells that obtain their gas supply the gasification of coal, with nuclear power plants providing their thermal energy. Such a hydrocarbon fuel-cell electric supply would compete with the local electric utility industry. Since research should be oriented toward less dissipation of energy, every fiscal encouragement should be given to manufacturers who develop appliances such as microwave ovens and stoves, ultrasonic dishwashers and washing machines, thermoelectric refrigeration and air-conditioning units, and electrochemiluminescent lighting panels.

25560

Cantrell, Robert R. and Forrest P. Wiley

RECOVERY OF SO2. (Grace (W. R.) and Co., New York) U. S. Pat. 3,538,681. 3p., Nov. 10, 1970. 2 refs. (Appl. Dec. 5, 1968, 6 claims).

A method is described which will remove sulfur dioxide from a gas stream even when it constitutes only a very small percentage of total gas flow. It involves the absorption, at 24 to 34 C, of SO2 by dimethyl sulfoxide (DMSO) in a typical countercurrent gas-liquid contact column. Subsequently, the SO2 is desorbed from the DMSO-SO2 mixture, at 40 to 90 C, by contacting the mixture with alumina or other suitable absorbent. Since the method has the potentiality for removing at least 99% of the SO2 from flue gases, it will enable power stations to continually burn cheap sulfur-containing fuels.

25584

Fredriksen, Helge

CAN EMISSIONS BE REDUCED? (Kan utslippene reduseres?). Text in Norwegian. Tek. Ukleblad (Oslo), 115(12):259-262, March 21, 1968. 5 refs.

The output of Norwegian hydroelectric plants, which was 49 billion in 1965, supplies about one half of the nation's electric power requirements, so that it is necessary to resort to organic fuels to meet the quota. The sulfur content of fuel oil present problems due to the emission of sulfur dioxide. The heavier the oil, the higher its sulfur content. In the Oslo area, a number 6 oil is sold that has only 2.5% S, but this is more expensive than the high-sulfur oil. Domestic heating must use about 15% of the heavier oils (number 3, number 5, number 6) while industry must mak use of about 25% of the lighter oils (number 1 and number 2). It has been calculated that the total SO2 emission resulting from the burning of fuel oils amounts to 120-130 million kg annually (1966). The heavier oils account for about 90% of this figure. Domestic heating is responsible for about 25 million kg, or 20% of the total SO2 emission figure. From 2 to 4% of the fuel-oil sulfur is emitted in the form of SO3, which tends to combine with atmospheric moisture to form sulfuric acid. A Swedish study has shown that particulate matter can contain 10-30% by weight of this sulfuric acid. A summary is given, from the literature, of the various procedures used for reducing sulfur oxide emissions, including chimney height, desulfurizing fuels, use of binders such as limestone and dolomite as additives to fuel, scrubbers, gravity precipitators, the Reinluft process, alkalized alumina, activated manganese oxide, and catalytic oxidation. The economics of desulfurization are also discussed.

25602

(Inventor not given.)

METHOD AND APPARATUS FOR MINIMIZING AIR POLLUTION. (Combustion Engineering, Inc., Windsor, Conn.) Brit. Pat. 1,180,568. 7p., Feb. 4, 1970. (Appl. Feb. 24, 1967, 8 claims).

One of the many sources of air pollution is the flue gases emitted from fuel burning equipment such as steam generating units. The sulfur dioxide and sulfur trioxide in such gases are a major concern as air pollutants. The particulate matter such as fly ash and other dust particles also contribute to pollution if not completely recovered. The schemes that have been developed to date to remove these obnoxious flue gas constituents have involved eithe high capital costs and/or high operating costs. The present invention provides a method and apparatus for economically removing the pollutants. According to the invention, inexpensive pulverized limestone or dolomite are added to the flue gas stream to produce harmless materials that are readily removed by subsequent wet scrubbing. After being scrubbed, the flue gases are reheated to raise their temperature so that no visible vapor plume is emitted, or localized air pollution caused by low-temperature, nonbuoyant gases issuing from the scrubber. Reheating is accomplished by introducing into the scrubbed gases one portion of a subdivided air stream, the temperature of the portion being higher than the temperature of the scrubbed combustion products. The other portion of the preheated air is used to form the hot air-fuel mixture for combustion. By eliminating the need to place a heat transfer surface area in the path of flue gas coming from the scrubber, the direct reheating considerably reduces capital expenses.

25637

Sieth, Joachim and Hans-Gunter Heitmann

APPARATUS FOR CONTINUOUSLY MEASURING THE CONCENTRATION OF A GAS- MIXTURE COMPONENT. (Siemens-Schuckertwerke AG, Berlin (West Germany) U. S. Pat. 3,367,747. 5p., Feb. 6, 1968. 4 refs. (Appl. March 11, 1964, 10 claims).

In combustion plants, particularly steam-boiler plants, the flue gases contain more or less considerable quantities of sulfur dioxide as well as traces of sulfur trioxide, stemming from the combustion of sulfurous fuels such as coal and oil. When the temperature of the flue gases drops below the dew point, the gases condense and may cause serious damage by corrosion in the boiler. Since the dew point is influenced substantially by the proportion of sulfur trioxide in the waste gases, it is desirable to provide means for measuring the SO3 concentration in a gas mixture. Accordingly, the concentration of SO3 and SO2 in a flow of smoke gas can be measured by performing the following steps: treating the flowing gas mixture continuously with condensing water vapor to selectively absorb SO3 from the mixture; continuously measuring the concentration of the sulfuric acid solution resulting from the reaction of the condensing water and the SO3, this concentratio being indicative of the SO3 concentration in the gas mixture; continuously treating the residual flow of gas, now free of SO3, with water to absorb SO2; and measuring the concentration of the sulfurous acid solution resulting from the reaction of water and sulfur dioxide, as indicative of the SO2 concentration in the gas mixture. The concentration of the sulfuric acid solution and/or the sulfurous acid solution is advantageously determined by electric conductivity measurements.

25663

Beeching, W. E. J.

FLUE-GAS WASHING TRIALS AND CONCLUSIONS. Mech. World Eng. Rec., vol. 68:88, 91, Jan. 25, 1935.

Flue gas washing efficiency in removing dust and sulfur during power station working conditions is considered. An experimental plant is described with four sprinklers in each of two towers, and a baffle at the base of a transverse chamber which separates the effluent water from the two towers. Results and observations concerning efficiency are presented tabularly. Tests were also conducted on samples of cement and dust in various proportions and the results compared with mixtures of cement and sand. It is proposed to deepen all thermometer pockets, and if necessary fill them with water. Rather than keep the flow restricted and reduce the size of the nozzle in the second venturi meter, it is also proposed to divert one of the pipes. Pitot readings are to be checked by the introduction of an anemometer. Further modifications are indicated.

25677

Quesnel, Guy and Pierre Theilmann

OIL-FIRED AND COAL-FIRED 600-MW BOILER OF THE POWER PLANT AT LE HAVRE. (La Chauffe au mazut et au charbon de la chaudiere de 600 MW de la centrale du Havre). Text in French. Sciences Techniques, no. 12:3-12, Nov. 1968. 4 refs.

Described is a boiler producing 1810 tons per hour of superheated steam at a temperature of 567 C and a pressure of 167 bars. This boiler feeds 600 megawatt a turbo-alternator unit which forms the second stage of construction of the new Electricite de France thermal power plant at Le Havre. Heavy fuel oil and pulverized coal can be burned separately or jointly; the consumption at full power is 129 tons per hour of fuel oil, 217 tons per hour of pulverized coal, or any intermediate depending on the oil-coal ratio. To keep up this rate of consumption a fleet of 16 ore ships of 50,000 register tons each or a fleet of 5 oil tankers of 100,000 register tons each is required. Correspondingly, between 2000 and 3000 tons per day of combustion wastes which can not be recovered in the waste-recovery plants, must be buried in deep trenches off Le Havre. Description of the boiler structure and the combustion chamber with tangential fuel injection from four recessed burners is followed by a discussion of the problem of burning fuel oil which may contain up to 4% sulfur. The tangential fuel injection combined with a small excess of combustion air injected from several points provides an excellent solution of this problem as it results in a small rate of conversion of SO2 into SO3 mixture, with a consequent decrease in the rate of corrosion of the metal panels surrounding the combustion chamber. The excess combustion air and the highest chimney in Europe (240 m) combine to lower the pollutant content of the exhausts and to disperse those that remain away from adjacent residential areas. Equipment for preliminary treatment of fuel oil and coal is described. The operations of the boiler is almost fully automatic and is protected by a system of continually monitored protective devices.

25702

Takahashi, Akira

RESEARCH AND DEVELOPMENT OF STACK GAS DESULFURIZATION PROCESS. Chem. Economy Eng. Rev., 2(3):17-20. March 1970.

Due to increasing consumption of sulfur-containing fuel oil, pollution by sulfur dioxide has become a pressing problem in Japan. Various promising flue-gas desulfurization methods have been studied during the past few years: the limestone (or dolomite) process, activated carbon process, activated manganese oxide process, Kiyoura-TIT catalytic oxidation process, and water-washing processes. The activated carbon and activated manganese oxide are described in detail, together with progress in their research and development. The former yields sulfuric acid as a by-product and the latter ammonium sulfate of commercial quality. Both processes have been tested in pilot plants, and major technical problems solved. Each will be used on a commercial scale by one or more electric power companies.

25743

Malachowski, Jan

PURIFICATION OF INDUSTRIAL EXHAUST GASES. (Oszyszczanie odlotowych gazow przemyslowych). Text in Polish. Rudy Metale Niezelazne, 12(10):532-537, 1967. 8 refs.

Several methods for sulfur dioxide removal from exhaust gases of power plants and chemicals and their utilization are discussed. In Czechoslovak power plants, the method used is basically circulation of absorbent (ammonium sulfite), which is saturated by SO2 at 20-35 C and releases SO2 into gas phase at 80-120 C. A new type of absorber with a packed bed consisting of aluminum spirals has been tested, which is cheaper and enables longer contact time. The optimum conditions of the process are discussed. The method used in the USSR is suitable for neutralization of gases with low SO2 content in the metallurgy of nonferrous metals. Sulfur dioxide is neutralized by ammonia and the ammonium sulfite obtained is treated by phosphoric acid. As a by-product, phosphoric fertilizer is obtained. The method has been tested and the parameters of the process analyzed. The method used in Rumania is basically the same, only the SO2 recovered is further used in sulfuric acid production. The parameters of the absorption process differ significantly from the Russian method. In Japan, SO2 from effluent gases is oxidized on vanadium contact. Gaseous ammonia is then introduced at 220-260 C to give ammonium sulfite. Alternatively, the gas after contact is cooled to about 95 C, which results in formation of 70% H2SO4.

25744

Kranz, Maksymilian, Marian Grala, and Marek Krzymien

THE DERIVATION OF GALLIUM AND ALUMINUM FROM COAL AND GAS DUSTS AND ASHES. (Proby wydzielania glinu i galu z pylow i popiolow weglowych i gazowniczych). Text in Polish. Poznan. Towarz. Przyjaciol Nauk, Wydzial Mat. Przyrod. Prace Komisji Mat. Przyrod., 12(3):3-11, 1968. 6 refs.

Methods of obtaining aluminum and gallium concentrates and eventually their complete isolation from coal and gas dusts of two Polish electric and gas works are reported. The amounts of Al and Iron in the dusts formed in the process of coal combustion in generators, boilers, and in dusts remaining in chimneys were determined to be 2-12% Fe203 and 1-9% Al203. Four different methods used to obtain Ga enriched material are described. Spectral analysis showed that only the methods of precipitation of gallium ferrocyanide and extraction by ethyl ether were successful. Spectral analysis also identified Fe, Al, and Mg as the main admixtures accompanying Ga. For Al separation, the methods of acidic and alkalic extraction were considered. The amount of Al in the dusts is up to 8% Al203. The generator dust is richer in Ga; the boiler dust, in useful metals like Cr, V, Ni, and Mo. These appear mostly in trace quantities. The method of their isolation has to be further developed.

25786

Busby, H. G. Trevor and K. Darby

EFFICIENCY OF ELECTROSTATIC PRECIPITATORS AS AFFECTED BY THE PROPERTIES AND COMBUSTION OF COAL. J. Inst. Fuel (London), vol. 184-197, May 1963. 4 refs.

The results of an investigation into the adverse performance of electrostatic precipitators on pulverized-fuel boilers firing certain coals from England and Australia are discussed. The effect of the electrical resistivity of the fly-ash is examined; when the resistivity of the dust exceeds about 10 to the 13th power ohm/cm, the efficiency of precipitation is reduced. The resistivity of the dust is determined by the surface condition of the dust particles. The adverse effect when resistivity is high ca be overcome by the injection of sulfur trioxide into the flue before the precipitator: this is completely absorbed by the dust. The formation of sulfur trioxide from combustion of the sulfur in the coal is an over-riding factor in determining precipitator efficiency and this, while broadly related to sulfur content of coal, is also affected by unknown factors in the combustion process. (Author abstract modified)

25787

Lindblad, A. R.

METHOD FOR MANUFACTURING SULFUR. (Satt att framstalla svavel). Text in Swedish. (Assignee not given.) Swed. Pat. 80,439. 2p., May 23, 1934. (Appl. Nov. 1, 1932, 2 claims).

A method is presented for use with gases containing sulfur dioxide derived from roasting or other processing of pyrites or other sulfur-containing ores, using coal or some other solid containing carbon as the reducing agent. This agent is mixed or impregnated with an alkali metal or alkali compound, such as sodium carbonate, sodium sulfate, or sodium sulfide. The alkali material acts as a catalyst, extremely effective against the formation of undesirable secondary products such as hydrogen sulfide, and its action extends beyond the time and place of contact between the gases and the solid reducing agent.

25795

Lindblad, A. R.

METHOD FOR MANUFACTURING SULFUR BY THE REDUCTION OF SULFUR DIOXIDE. (Satt att framstalla svavel medelst reduktion av svavelsyrlighet). Text in Swedish. (Assignee not given.) Swed. Pat. 85,183. 2p., Jan. 9, 1956. (Appl. Sept. 6, 1955, 10 claims).

The gas mixture containing sulfur dioxide is introduced into a specially constructed chamber, where it is heated by the hot reaction products produced by the reduction process. The SO2 mixture is passed through one or more channels arranged inside the reaction chamber or along its periphery, and moves in the opposite direction to the gases formed by the reaction. Thus, the mixture containing SO2 may be introduced near the lower end of the reaction chamber, after which it moves upward through the chamber, absorbing the heat of reaction as it goes. It comes in contact with the reducing agent (which can be a gas) at the top of the chamber and moves downward as they react. The sulfur produced by the reduction process is removed from the bottom of the apparatus. Producer gas or blast furnace gas can be used as the reducing agent, or possibly powdered coal.

25833

Watkins, E. R. and K. Darby

ELECTROSTATIC PRECIPITATION FOR LARGE BOILERS. Proc. Inst. Mech. Engrs. (London), vol. 181, part 3N:78-89, 1966-1967. 3 refs.

Because it contributes nothing to the overall efficiency of the station in terms of cost per unit generated, the electrostatic precipitator has been the least understood item of equipment at the average power station. The lack of interest has resulted in poor maintenance and operation and thus poor efficiency of gas cleaning. With the increasing awareness of the health hazards from atmospheric pollution, this attitude is changing. Design, operation, and maintenance factors of vital concern if high efficiency is to be maintained are highlighted. Mechanical and electrical design considerations noted include casings, collector systems, discharge systems, insulators, mechanical and static rectifiers, 'sectionalization' of precipitators, hoppers, and automatic control. Recommendations made for operation and maintenance cover initial commissioning, checks during normal operation, analysis and location of faults, and periodic major overhauls.

25913

Heredy, Laszlo A.

ELECTROCHEMICAL PROCESS FOR RECOVERING SULFUR VALUES. (North American Rockwell Corp., Canoga Park, Calif.) U. S. Pat. 3,531,386. 5p., Sept. 29, 1970. 4 refs. (Appl. Nov. 26, 1968, 5 claims).

A method is described for recovering sulfur values from molten salt compositions using inexpensive readily available materials and avoiding the use of expensive equipment. Sulfur oxides, principally as sulfur dioxide, are present in the waste gases discharged from many metal refining and chemical plants and in the flue gases from electric power plants. The electrochemical recovery of sulfur values from the molten salt as sulfur oxides in the anode compartment, and the simultaneous formation of alkali metal carbonate in the melt in the cathode compartment, is accomplished by feeding the molten salt composition to the anode compartment while simultaneously using carbon dioxide and oxygen as cathodic feed material.

25973

(Inventor not given.)

METHOD OF MANUFACTURING SULFUR FROM GASES CONTAINING SULFUR DIOXIDE. (Sistema per la produzione di zolfo da gas contenenti anidride solforosa). Text in Italian. (Pyrites Co., Ltd., London (England)) Ital. Pat. 380,818. 6p., June 5, 1950. (Appl. Feb. 22, 1940, 9 claims).

A process is described which is intended for use with gas mixtures containing at least 12% sulfur dioxide and little or no oxygen. The gas is passed over a mass or column containing a carboniferous material. The gas is introduced at the top of the column or mass, and the product is removed from the lower end. Dust is removed from the gas before processing, by passing the gas through a cyclone made of refractory material. The process should be carried out at a temperature of no less then 850 C.

26063

Rathgeber, Ferdinand

ELECTRIC FILTERS FOR DRY AND WET SEPARATION. (Elektrofilter fuer Trocken- und Nassabscheidung). Text in German. Wasser Luft Betrieb, 14(1):456-460, Nov. 1970.

Recent improvements of electric filters deal with increasing operating reliability, with increasing capacity, with prolonging the life of the equipment, and with adapting the equipment to properties of different dusts. As a result, various modifications of sparking and of precipitation electrodes were produced. In some areas, a combination of electric filtration with other dust removal methods was found advantageous. The trend is towards the building of compact units. Another improvement consists of the introduction of unbreakable electrodes. Wet electric filters have not found as wide application as dry filters. A newly developed wet filter consists of a battery of identical wet elements intended for the separation of aerosols, of dust, of soot, and for the recovery of valuable waste gas components. Examples of the application of improved dry and wet electric filters include dust separation of power plant flue gases and of larger incinerator flue gases which sometimes must be cooled prior to dust removal, dust separation in cement manufacture, gas purification in non ferrous metal smelting plants, the recovery of valuable materials from waste gases from metallurgical processes, and dust removal in the iron and steel industry.

26084

Juntgen, H. and K. H. van Heek

COURSES OF REACTION UNDER NON-ISOTHERMIC CONDITIONS. (Reaktionsablaufe unter nicht-isothermen Bedingungen). Preprint, Bergbau-Forschung G.m.b.H., Essen-Kray (West Germany), Steinkohlenbergbauverein, p. 601-699, 1970. 195 refs. Translated from German. Belov and Associates, Denver, Colo., 127p., March 16, 1970.

A review of the literature and preliminary experimental results are presented for the kinetics of chemical reactions and physical process under conditions of chronological and spatial changes in temperature. Based on fundamental equations which describe the course of such reactions, the methods used to determine the order of reaction, the activation energy, and the frequency factor are discussed, and experimental methods in current use for determination of kinetic parameters are evaluated. Various investigations and results on the release of water from salts and hydroxides, the calcination of carbonates and oxalates, reactions of metallic oxides and carbonates with sulfur dioxide, and reactions on carbon surfaces are surveyed, and the application of the non-isothermal method to the thermal decomposition of carboxylic acids and polymeric plastics as well as to the pyrolysis of natural substances (particularly bituminous coal) is explained. Chemical reactions in a liquid phase, the desorption of gases from solids, annealing processes disturbed crystal lattices, and the emission of exoelectrons from metallic surfaces are also discussed. (Author abstract modified)

26143

Forrest, J. S. and H. J. Lowe

PRESENT PERFORMANCE AND SCOPE FOR IMPROVEMENT IN POWER-STATION ELECTROSTATIC PRECIPITATORS. (Inst. of Mechanical Engineers, London (England), Proc. Conf. Mech. Engrs. Contrib. Clean Air, London, 1957, p. 42-59. 8 refs.

The results of tests to determine the performance of electrostatic precipitators, and combined electrostatic and mechanical dust arrestors at power stations are presented. The collecting efficiency of 30 stations in England ranges from 95% to over 99.5%, with a mean value of 98.5%. The present capital expenditure of England's Central Electricity Authority is over $5.8 million per year. Important features of precipitator design are discussed, and information is given on operating experience. The performance of precipitators is affected by dust characteristics. Since the dust is a complex mixture difficult to describe in terms of a singl parameter, it is often described in terms of the terminal velocity of the particles in cm/sec, or 'vels'. Future developments in precipitator design are considered, particularly improved methods of electrical control. An indication is given of the scope for overall improvement in plant performance. A discussion of the paper is included with the text. (Author abstract modified)

26155

Rassow, B. and K. Hoffmann

THE FORMATION OF CARBON DISULFIDE RESULTING FROM THE REACTION BETWEEN SULFUR DIOXIDE AND COAL. (Ueber die Bildung von Schwefelkohlenstoff bei der Einwirkung von Schwefeldioxyd auf Kohle). Text in German. J. Prakt. Chem., vol. 104:207-240, 1922. 49 refs.

The formation of carbon disulfide from the reaction between sulfur dioxide and charcoal under conditions of white heat was followed analytically over the entire temperature range. At 700 C only traces formed, from 750 C on a steadily increasing amount of CS_2 formed aside from carbon oxysulfide, CO_2, sulfur vapors and at first a small quantity of CO. The formation of CS_2 reached its maximum at 850-900 C. The sulfur from SO_2 was at this temperature divided between CS_2 (35%), COS (55%) and free sulfur (10%) with small quantities of CO and CO_2 completing the composition of the gas mixture. Above 900 C the quantity of free sulfur increased at the cost of CS_2 and COS. The oxygen from SO_2 appeared almost entirely in the form of CO aside from the share in COS. Above 1100 C no CS_2 formed; COS formed only in small quantity; free S and CO were the only reaction products. The process has no technical application because even under the most favorable conditions great quantities of COS form which is explosive when mixed with air and is difficult to handle.

26211

Gollmar, Herbert A.

REMOVAL OF SULFUR COMPOUNDS FROM COAL GAS. In: Chemistry of Coal Utilization. Vol. 2, New York, Wiley, 1945, Chapt. 26, p. 947- 1007. 213 refs.

A comprehensive review of past and present technology for the removal of sulfur compounds from coal gas is presented. Hydrogen sulfide is identified as the principal compound, constituting 90-95 of the total sulfur. The balance is conventionally but erroneously referred to as organic sulfur. It consists of about 2/3 carbon disulfide and an assortment of thiophenes, mercaptans, thio ethers, organic disulfides, and carbonyl sulfide. The sulfur in coal gas comes from the sulfur in the coal that is carbonized. Removal techniques were originally devised to eliminate the odors associate with the combustion of H_2S, followed by recognition of the corrosiv properties of sulfur compounds dissolved in water. The current demand for low sulfur coal gas to support an ever increasing number of chemical processes and special metallurgical alloying requirements is forcing the allowable sulfur content in coal gas to continually lower levels. The technology of sulfur removal over th last 150 years is reviewed. The original attempts to use milk of lime resulted in solid deposits and plugging. Scrubbers using solid lime were used a few years later, followed by the use of sulfided lime and then oxide purifiers. Liquid purifiers came on the scene about 1880, using ammonia liquor washes, and opening the door to sorbent regeneration. The effects of tar, naphthalene, and hydrocyanic acid, normal constituents of coal gas, on the desulfurization process are discussed. By-product recovery started with converting the sulfur to sulfuric acid, and that process remains today the principal recovery technique. Variations include the recovery of H_2S, ammonia, and elemental sulfur. The nature of the recovered product is usually dictated by economic considerations.

26220

Kovach, J. L.

THE EVALUATION OF THE IGNITION TEMPERATURE OF ACTIVATED CHARCOALS IN AIR, STEAM, OXYGEN AND OXIDES OF NITROGEN. International Atomic Energy Agency, Vienna (Austria), Symp. on Treatment and Control of Airborne Radioactive Wastes, New York City, 1968, p. 439-447. 20 refs. (Aug. 26-30.)

The ignition temperature of impregnated and unimpregnated activated charcoals currently used for the adsorption of various forms of radioactive iodine was evaluted. Standardized quartz ignition temperature apparatus was utilized, and the inlet air and charcoal temperatures were increased at a 10 C/min rate until 150 C was reached. After reaching 150 C, the temperature was increased by 5 C/min. Standard rotameters were used to measure gas flow, while the use of multiple rotameters permitted the control of gas concentration to obtain: air at 70% RH at 30 C, air at 100% RH at 75 C, and air-steam mixture where 50% of the available oxygen is in the form of air and the other 50% is introduced as steam, and air bubbled through concentrated nitric acid at 30 C. Atmospheric conditions and gas-charcoal residence times existing in nuclear power reactor containment recirculating filter systems, emergency off-gas filter systems, and fuel reprocessing plant filters were simulated. The ignition of activated charcoals not treated to increase ignition temperature is more likely in low humidity systems or when nitrogen dioxide is present in the air stream. Precautions must be taken if an intermittent air flow is used and if possible, this should be avoided. The presence of large amounts of steam significantly lowers charcoal ignition hazards, while the presence of impregnated iodine increases the ignition temperature. (Author abstract modified)

26230

Perrine, Richard L. and Limin Hsueh

POWER AND INDUSTRY: CONTROL OF SULFUR DIOXIDE EMISSIONS. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 10, 8p., Sept. 1, 1970. 20 refs.

Sulfur dioxide emissions result primarily from the burning of sulfur-containing fossil fuels, and total SO2 emissions to the atmosphere in the U. S. are estimated at more than 28 million tons/year. Large quantities of relatively low-sulfur fuel oils now are available from Indonesia and Alaska, substantially reducing the problem from what it otherwise could be. To date, none of the many direct removal processes appear to be able to break even in terms of recovery of salable by-products: elemental sulfur, sulfuric acid, or ammonium sulfate. Methods to desulfurize oil are available and the only factor is process economics, but coal desulfurization is very difficult. Two basic limestone-dolomite injection processes are being investigated, but the processes give no valuable by-products. Several leaching processes are mentioned, but these have the disadvantage that washing chills stack gases, losing normal buoyancy. Thus reheating is required. High capital and operational costs are involved with absorption and adsorption processes, while the principal need with catalytic oxidation is development to permit effective processing of dilute gases at temperatures lower than presently required. Reduction processes are also cited.

26237

Seifert, Werner and Gerhard Wolkenberg

SPECIAL FEATURES OF THE 140 MW TURBINE OF THE DUISBURG POWER PLANT. (Besonderheiten des 140 -MW-Blockes der Stadtwerke Duisburg). Text in German. Siemens Z., 43(3):155-159, March 1969. 6 refs.

The turbine built in 1964 by Siemens for the Duisburg power plant as an additional source of electricity had to meet specific local needs with regard to construction, circuit and control. The meet the rising heat consumption of Duisburg, the new block supplies heater current of 2 times 75 G cal/h, the amount projected for 1972. Two preheaters are provided which will be connected to the existing heating system. For peak heat requirement hot water is stored in vertical reservoirs of 900 cu m capacity at 11 atm and at 187 C. The block is so constructed as to meet a peak requirement of 200 MW between 7 am and noon and 50 MW between midnight and 6 am. To render slag discharge dust-free, the slag leaves the boiler furnace in liquid form. A cyclone is provided. Fully automatic equipment is provided for the operation of the turbine, for feed water pumps, for low load boiler control, for the peak load reservoir, and for armature control.

C. MEASUREMENT METHODS

00403

V. Jirasek

(ON THE SULFUR BALANCE IN STEAM GENERATORS.) Prispevek k Bilanci Siry, Parnich Kotlu. Energetika (Prague) 16(4): 169-176, Apr. 1966. Czeck Text

The methodology for experimental determination of the sulfur balance in steam generators (i.e. the distribution of sulfur between the slag, fly ashes, and gaseous combustion products) is described. The sources of various errors and their magnitude, and the accuracy of the overall sulfur balance computation is discussed in detail. Measurements carried out on basic types of Czechoslovak steam generators employing diverse means of combustion are reviewed. It is deduced that with existing methods of combustion the predominant part of the sulfur leaves together with the gaseous combustion products, and constitutes the basic amount of sulfur emitted into the surrounding. In common cases, it appears that better accuracy of sulfur-emission determination can be achieved by computation from the sulfur content of the fuel and the solid combustion products than by direct measurement of sulfur dioxide contained in the gaseous combustion porducts. (Author's summary)

00886

J. McK. Ellison

THE NATURE OF AIR POLLUTION AND THE METHODS AVAILABLE FOR MEASURING IT. Bull. World Health Organ. (Geneva), 32(3):399-409, 1965.

At present the principal sources of energy in Europe are coal and oil and fuels derived from them, and in European towns air pollution consists mainly of their combustion products. These combustion products naturally divide into two categories, gaseous and particulate, which are very different chemically and which behave very differently when they are near collecting surfaces; they therefore require very different techniques both for collecting and for estimating samples. Some methods of measurement, suitable for everyday routine use in Europe, are described; these offer a compromise between completeness and economy, and can help to give a general outline of the air pollution situation without undue complexity or prohibitive cost. (Author's summary)

00945

E. K. Diehl, F. du Breuil, and R. A. Glenn

POLYNUCLEAR HYDROCARBON EMISSION FROM COAL-FIRED INSTALLATIONS. J. Eng. Power, 89(2):276-282, April 1967. (Presented at the IEEE-ASME Power Generation Conference, Denver, Colo., Sept. 18-21, 1966, Paper No. 66-Pwr-2.)

Trace quantities of the polynuclear hydrocarbons have been identified in flue gases resulting from combustion of carbonaceous fuels. Some of these hydrocarbons, particularly benzo(a)pyrene, possess known carcinogenic properties and are of some concern in the overall assessment of the effects of atmospheric pollution. An investigation was carried out under a two-year grant received from the U.S. Public Health Service to determine the occurrence of polynuclear hydrocarbons in the flue gases from various coal-fired steam-generating installations. The paper describes the preliminary work leading to the development of satisfactory sampling and analytical procedures and gives the results obtained from sampling various field installations. (Author abstract)

01354

M. Lippmann, H. J. DiGiovanni, S. Cravitt, P. Lilienfeld

LIGHTWEIGHT, HIGH-VOLUME ELECTROSTATIC PRECIPITATOR SURVEY SAMPLER. Am. Ind. Hyg. Assoc. J., Vol. 26:485-489, Oct. 1965.

A high-volume (27-cfm) electrostatic precipitator survey sampler is described. It collects air-borne particles of all sizes with high efficiency on a tube 1 3/4 inches in diameter and 12 inches long. The unit consists of a five-pound sampling head containing the electrodes and air mover and a high-voltage power supply weighing six pounds. The sampling head can be hand-held for breathing zone sampling, or the two parts can be clamped together and tripod-mounted for fixed-position sampling. The sampler can be used with a cyclone precollector, without a significant flow reduction, for respirable dust sampling. (Author abstract)

01363

H.J. Ettinger

IODINE SAMPLING WITH SILVER NITRATE-IMPREGNATED FILTER PAPER. Health Phys., Vol. 12:305-311, March 1966.

The use of silver nitrate-impregnated 'radioiodine filters' was evaluated under laboratory and field conditions. Preliminary laboratory tests indicated 'radioiodine filter' efficiencies of 91-96 per cent. When sampling a stack effluent containing a variety of reactor waste products 'radioiodine filter' efficiencies of less than 8 per cent were obtained. Sampling effluent gases from hot cells where reactor fuel elements are handled resulted in a median 'radioiodine filter' efficiency of 20 per cent, with efficiencies as high as 96-100 per cent under certain operating conditions. Test results show that silver nitrate-impregnated 'radioiodine filters' do not provide a reliable method for monitoring the release of iodine to the atmosphere. (Author abstract)

01856

F.E. Gartrell

MONITORING OF SO2 IN THE VICINITY OF COAL-FIRED POWER PLANTS - TVA EXPERIENCE. Proc. Am. Power Conf. (Presented at 27th Annual Meeting of the American Power Conference, Chicago, Ill., Apr. 27-29, 1965.)

During the relatively short period of approximately fifteen years, TVA has conducted extensive air pollution studies at eight large, modern, coal-fired, steam-electric generating stations as these plants were added to the TVA power system. The plants vary in unit size, stack heights, fuel supply, site topography, and micrometeorology. This paper presents summaries of some of the significant findings of these studies which should be of value in planning air pollution control for large coal-fired power plants. (Author summary)

01857

D.H. Grindell

MONITORING SMOKE AND FLUE-DUST EMISSION. AEI ENGINEERING 2, (5) 4179-71, 1962.

Several methods are available for measuring the offensiveness of industrial smoke, the actual physical quantity measured tending to be different in each case. The AEI electrostatic dust monitor described in this article measures the surface area of dust passing a selected point in a flue duct in unit time, a quantity shown to be highly relevant in assessing air pollution. Monitors of this type have been found to operate satisfactorily and reliably in service. They provide a continuous record of dust emission from the flue ducts in which they are fitted and respond rapidly to sudden changes in the dust burden of the chimney gases. (Author abstract)

02655

L. Narjes

THE USE OF NEW ZERO-PRESSURE FOR PROBES FOR QUASI-ISOKINETIC SAMPLING IN STEAM-POWER PLANTS. Staub (English Translation) 25, (4) 11-8, APR. 1965 CFSTI TT66-51040/4

Reports on the application of a new zero-probe for taking dust samples at high concentrations in coal-dust streams and the behaviour of the probes under diverse in-flow conditions in a test channel is investigated. Further, results of measurements on conveying lines for coal dust at a stream power plant are reported. Apart from this the suitability for plant use and results of measurements with the probes in dust measurements are discussed. (Author summary)

02668

H. Bresser and W. Hansch

A METHOD FOR CALCULATING SO2 IMMISSIONS IN THE SURROUNDINGS OF LARGE POWER STATIONS. Staub (English Translation) 25, (6) 20-4, JUNE 1965. CFSTI TT 66-51040/6

Describes a method which makes possible a statistical calculation of the SO2 immissions to be expected in the surroundings of a large power station. The calculation method is based on the determination of propagation parameter according to Sutton, combined with a correction of the propagation formula with regard to the change in the average wind direction. The required exponents can be evaluated if the daily weather reports are interpreted as a function of wind velocity profiles. The results are compared with calculations based on the Pasquill method. (Author summary)

02921

F. E. Gartrell, F. W. Thomas, and S. B. Carpenter

ATMOSPHERIC OXIDATION OF SO2 IN COAL-BURNING POWER PLANT PLUMES . Am. Ind. Hyg. Assoc. J. 24, 113-20, Apr. 1963. (Presented at the 23rd Annual Meeting, American Industrial Hygiene Association, Washington, D.C., May 1962.)

Sampling equipment and procedures applicable for use in a helicopter were devised for collecting the separate SO2 and SO3 components in progressive plume cross sections at a large coal burning power plant. Samples were collected during a variety of meteorological conditions with particular attention to a wide range of relative humidity. During periods of low humidity, data reveal that oxidation of SO2 is relatively slow, increasing from 2% at one mile (12 min) to 3% at 6 miles (60 min). With moderately high humidity, oxidation was initially rapid, 22% at one mile (12 min), increasing to 32% at 8 miles (96 min). The highest total oxidation, 55%, was observed in a slight mist at 9 miles (108 min). (Author abstract)

03460

H. A. Belyea, R. W. Johns, F. W. Taylor, and W. Surh

STACK EMISSION COLLECTOR. Preprint. 1962.

Stack Emission Collectors are relatively small test devices which may be placed in a stack for a period of time and which collect (by the settling process) a sample of the relatively large sizes of particulate matter in stack emissions, the fine or light particles continuing on through the S.E.C. The particles retained in the collector are of a size and density which would fall within several stack heights of the source of the emission and the weight of the collected sample is a measure of the nuisance created by the source. As well, an estimate or approximation of the total emission (all sizes of particles) from the source can be made whenever the kind or class of the effluent or a size and density determination of the particulate matter is known.

03546

W. D. Conner J. R. Hodkinson

OBSERVATIONS OF THE OPTICAL PROPERTIES AND VISUAL EFFECTS OF SMOKE PLUMES. Preprint. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 21-25, 1964, Paper No. 64-117.)

Detailed observations are reported on the reduction in contrast between targets seen through white experimental plumes of various transmittances, on the contrast between white experimental plumes and their background, and on the great effect of varying conditions of lighting and observation. The variations in plume transmittance for light of different wavelengths and the angular distribution of light scattered by the experimental white plume and oil-burning electric plant plume have also been measured, and estimates of mean particle-size derived therefrom. Trials have been made to ascertain how well observers can be trained to estimate visually, under different conditions, the transmittance of light and dark plumes. (Author abstract modified)

03592

S. T. Cuffe

AIR POLLUTANTS FROM POWER PLANTS (TECHNIQUES FOR EVALUATING AIR POLLUTANTS). Arch. Environ. Health 6, 422-7, Mar. 1963. (Presented at the 27th Annual Meeting, Industrial Hygiene Foundation, Pittsburgh, Pa., Oct. 24-25, 1962.)

The objective of the study is to evaluate the emissions of oxides of nitrogen, oxides of sulfur, polynuclear hydrocarbons, total hydrocarbons, total solids, formaldehyde, organic acids, and common metals in the gases emitted from various types of coal-burning power plants which may be useful in establishing the range of atmospheric emissions under various conditions of operation. Determination of the efficiencies of control equipment is also essential for the long-range objective of reducing total air pollution. This paper describes the sampling and analytical techniques used in evaluating the several types of emissions under study.

04040

E. J. Schulz, R. A. Duffee, R. I. Mitchell, and E. W. Ungar

A TRACER TECHNIQUE TO MEASURE DEPOSITION OF STACK EMISSIONS. Am. Ind. Hyg. Assoc. J. 21, (5) 343-9, Oct. 1960.

The uranine tracer technique is a useful tool in the quantitative measurement of the particulate deposition rate of industrial emission. The variable decompositions of uranine solutions exposed to the atmosphere in dust-fall containers prevents the use of dust-fall jars as sampling devices. Based on the laboratory study, uranine can be dispersed as a tracer into stack at stack-gas temperatures up to 600 F without decomposition. With direct stack injection, losses of tracer in the stack must be determined for each application. In using uranine it is mandatory that background fluorescence be determined in the area to be investigated. However, the technique is not limited to uranine. Any soluble material that satisfies the requirements of a tracer can be employed with this method.

04759

J. R. Hodkinson

THE INTERPRETATION OF MIE-THEORY COMPUTATIONS FOR ABSORBING SPHERES IN RELATION TO LIGHT-SCATTERING METHODS OF AIRBORNE DUST MEASUREMENT. STAUB (Duesseldorf) 23, 374-8, 1963. Ger. (Tr.)

Mie-theory computations of the angular scattering diagrams of moderately absorbing spherical particles larger than the wavelength have been published by OLAF and ROBOCK (1961), and the application of these results to the interpretation of light-scattering measurements on such particles has been discussed by ROBOCK (1962). This note compares these Mie-theory results with simpler computations of the angular scattering by moderately-absorbing spheres from the formulae of large-particle classical optics; points out that the Mie- theory does not apply to irregular particles such as constitute the airborne-dust clouds in mines; and discusses briefly the principles governing the measurement of dust concentration by light -scattering methods.

04889

J. M. Lepper

PORTABLE INFRARED REMOTE S02 SENSOR (THIRD QUARTERLY S02 REPT.) Dalmo Victor Co., Washington, D. C. Apr. 10, 1967 9 pp.

This is a report of work concerning the present state of SO2 Sensor system, demonstrated capability, and problems. The SO2 Sensor has been operational for the past month and a half. During the month of January the internal computer was checked out and found to meet the requirements described in the Second Quarterly Report. The IR filters are all within specification and behave as predicted. The test tank was completed and the sensor system coefficient determination was started. Coefficient calculations were made for 2, 3, or 4-vector problems; i.e., spectral situations where 2, 3, or 4 components are in the field of view. The 2-vector situation is realized in practice when looking at plumes from natural gas burning power plants where the spectrum is dominated by CO2 and H2O with only 150 PPM of SO2 present. An example of the 3-vector problem in the field would be a fuel oil burning system with moderate amounts of SO2 being present. The 4-vector problem occurs when viewing coal burning sources with the fourth spectral component due to flyash. Field tests were begun in early March with a 2-vector calculation being done on the Pacific Gas and Electric Company's natural gas burning power plant. Further two-vector work was done at several oil refineries, primarily for signal-to-noise measurements. At this writing the equipment is disassembled for primarily optical alignment. This optical alignment consists of precision machining of the optical chassis. Although the IR optics involves only 2 mirrors and the detector, accurate alignment is necessary to insure on-axis operation. Also, alignment of the sighting telescope to the IR telescope is necessary.

05216

TENTATIVE METHOD FOR CALCULATIONS OF THE DISPERSION OF DISCHARGES IN THE ATMOSPHERE . Byul. Stroit. Tekhn. (11), 29-31 (Nov. 1963). Russ. (Tr.) (Translated as JPRS 22,598.)

On 25 July 1963, the State Committee on the Coordination of Scientific Research Work USSR confirmed 'Tentative Procedure for Calculating the Dispersion in the Atmosphere of Discharges from the Smokestacks of Electric Power Plants'. Development of theory of turbulent diffusion, as well as new experimental data made it possible to compile a procedure for calculating the dispersion of smokestack discharges from electric power plants in the atmosphere, to determine stack height requirements, and establish standardization of discharges. The degree of danger of contamination of the ground layer of air by discharges from the stacks of electric power plants should be determined according to the greatest value of the ground concentration of harmful impurities in the air (cM), which can be established at some distance from the stacks (xM) under unfavorable meteorological conditions. In this case the value of the maximum concentration cM (in mg/cu m) on level or slightly broken terrain, with a uniform discharge of toxic substances from stacks (N) of the same height should be calculated according to the formula: cM=AMFm/H2(N/V d T)1/3; where A is a coefficient depending on the temperature stratification of the atmosphere, which determines the conditions of vertical and horizontal dispersion of the impurity in the air (in sec 2/3 deg 1/3); M is the summary discharge of the toxic impurity from all the stacks (in g/sec); H is the height of the stack (in meters); V is the summary volume of smoke gases discharged from the stacks per second (in cu m/sec); dT is the difference between the temperature of the gases emerging from the stack and the temperature of the surrounding air (in deg); m and F are dimensionless coefficients; the coefficient m is related to a consideration of the influence of the rate of emergence of the smoke gases from the mouth of the stack, while the coefficient F is related to a consideration of the influence of the rate of settling of the impurity in the atmosphere. This formula is suitable for calculating the concentration of impurities emerging from smokestacks at H greater than 50 m; V/N greater than 20 cu m/sec, and dT greater than 30 degrees. When the contour of the terrain does not correspond to the conditions indicated above, special instructions must be sought from the Main Administration of the Hydrometeorological Service under the Council of Ministers USSR and the (state Sanitary Inspection USSR.

06095

C. V. Kanter, R. G. Lunche, A. P. Fudurich

TECHNIQUES OF TESTING FOR AIR CONTAMINANTS FROM COMBUSTION SOURCES. J. Air Pollution Control Assoc. 6 (4), 191-9 (Feb. 1957). (Presented at the 49th Annual Meeting, Air Pollution Control Association, Buffalo, N.Y., May 20-24, 1956.)

The Air Pollution Control District (APCD) in the past 8 years has made more than 800 test, including many on incinerators and power plant boilers. The tecniques used in testing these combustion sources are described. These techniques are based on principles and procedures which have been in use for many years and have been described in the literature. In most air pollution control studies of combustion sources, attention has been largely focused on the amount of particulate matter discharged. In the testing program of the APCD, methods for measuring other contaminants in the gaseous state have been established. These methods are recommended to other agencies investigating air contamination from combustion sources.

07482

Kanno, S.

DETERMINATION OF GASEOUS AIR POLLUTANTS. Text in Japanese. J. Jap. Petrol. Inst. (Tokyo), 7(2):92-96, Feb. 1964. 6 refs.

The determination of sulfur oxides and nitrogen oxides in smoke and in air are covered. SO2 in smoke is measured colorimetrically or by detection tube. Two methods are described: one for measuring pollutants after the combustion of coal or heavy oil or for gases mixed with NO2 and the other for mixtures of SO2 and SO3. Procedures are given for making the test liquid (absorption liquid) and for exact measurement for each method. The detection tube is illustrated briefly. The absorption tube method is not sufficient for NO2 detection. A method of almost perfect collecting efficiency which is used in the Kanagawa Prefecture Public Health Laboratories is described. The absorber is composed of a mixture of NaOH and butanol. For SO2 and SO3 measurement, the electric conductivity method and barium molybdate method are illustrated. The rosanaline method is used as well as an alkali filter paper method. The latter is superior to the widely used PbO2 method in that reagent quality does not affect the measured value and the collecting efficiency does not depend on temperature and humidity.

07516

Walker, F. E. and F. E. Hartner

FORMS OF SULFUR IN U. S. COALS. Bureau of Mines, Washington, D.C., Inform. Circ. 8301, 51p., 1966.

The Bureau of Mines determined total sulfur forms for coal in 283 counties in 29 States and 2 fields of the State of Alaska. Specifically, organic, pyritic, and sulfate sulfur were measured of approximately 2,900 samples, and they include most of the coalbeds in the United States. A step-by-step procedure for these determinations is included. (Authors' abstract, modified)

07721

Uzima, M.

SIMPLIFIED METHOD OF MEASUREMENT OF QUANTITY OF SOOT & DUST, AND ITS RELATIONS OF ((SIC)) SMOKE CHART. Text in Japan- ese. Netsu Kanri (Heat Engineering) (Tokyo), 19(1):11-16, Jan 1967.

The East-North Power Station together with the Central Electric Power Institution studies a simpler method to standardize dust and soot-measuring methods. They tried to find the point which gives the average amount of soot and dust without measuring the distribution of concentration. They also investigated the possibility of measuring the amount of soot and dust in grams/cubic meter using a soot and smoke meter of the photoelectric type. In this experiment, the temperature distribution, velocity distribution, and soot and dust concentration at the cross-section of the smoke duct were measured. Measurements were also made at the inlet and outlet of the dust collection device. For measuring concentration, at the inlet, the constant-velocity suction tube method was used, a dust tube alone was used when heavy oil was the fuel, and at the outlet, both tubes were used. When coal was used as fuel, the size of the dust particles was 30 to 40 microns at the inlet and 5 to 7 microns at the outlet. It was found that the curves of the velocity of the gas and of the soot and dust concentration were almost the same indicating that the average amount of soot and dust could be measured at the point where the velocity of the gas was average. Measurement of the distribution of soot and dust is only required for determining dust collecting efficiency.

07787

Delange, J. E.

A CRITICAL LOOK AT METHODS, PROCEDURES AND APPARATUS FOR EVALUATING THE EFFECTIVENESS OF DUST ARRESTING EQUIPMENT ON LARGE COAL-FIRED STEAM GENERATORS. Preprint, Detroit Edison Co., Mich., Engineerin Research Dept., ((22p.)), 1967. 6 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Assoc., Cleveland, Ohio, June 11-15, 1967, Paper No. 67-121.)

The test methods, procedures, and apparatus based on the experience of The Detroit Edison Company in conducting performance tests on mechanical dust collectors and electrostatic precipitators on large coal-fired steam generators are reviewed. A special test apparatus, which employs the null sampling method for determining the dust concentration in a gas stream, is described and the advantages of the use of this type of apparatus for certain applications are noted. (Author0s abstract)

07848

Short, W.

MEASUREMENT OF GRIT AND DUST EMISSION. Fuel Econ, Vol. 44, p. 89-91, 1966. 5 refs.

A cyclone and filter method developed by the British Coal Utilization Research Association combining reasonable accuracy and easy portability has been used since 1958 for determining grit and dust emission. Emissions from a chimney can be calculated as the weight of grit and dust passing the sampling plane minus the weight collected by the arrestor. Results show that, in many cases, quite low emissions are obtained without grit arrestors. When high emissions are reported where no grit arrestor is fitted at the time of test, a simple arrestor of stack or scroll type with induced draught fan would reduce emission to a low and acceptable figure if a 60% collection efficiency were achieved. For oil-fired boiler plants using oil, the ash content is very low, and emissions will largely consist of carbon particles; appreciable quantities of solid particles can also be emitted if badly operated or poorly maintained. Factors that seem to influence production of fine particles are oil preheat temperature and excess air percentage.

07941

S. C. Goadby, J. F. Stephens

DETERMINATION OF SULPHUR IN FLY-ASH BY X-RAY EMISSION SPECTROSCOPY. Fuel, 46(1):19-24, Jan. 1967. 11 refs.

A simple procedure based on the method of additions and the technique of X-ray emission spectroscopy is described for the determination of total sulphur present at low levels in fly-ash and similar materials. The precision and accuracy of the method for the range of 0.1 to 0.5 per cent sulphur are discussed. (Authors' abstract)

08123

A. I. Vronskiy, A. S. Slutsker, Y. V. Khukhrina

COMPARATIVE EVALUATION OF NEW METHODS OF DETERMINATION OF THE DUST CONTENT OF AIR. In: A. A. Letavet and Ye. V. Khukhrina (eds.), Methods of Studying Industrial Dust and the Incidence of Pneumoconioses. (Metody izucheniya proizvodstvennoy pyli i zabolevayemosti pnevmokoniozami.) Leningrad, Meditsina Publishing House, 1965, 123p. Translated from Russian. Clearinghouse for Federal Scientific and Technical Information, Washington, D. C., Joint Publications Research Service TT 66-30952, p. 22-32, March 11, 1966. 2 refs.

Comparative tests of gravimetric and counting apparatuses for the determination of the dust content of air are discussed. The procedure with the use of AAF-W-10 filters is recommended instead of GOST-50, as the most progressive and reliable one; the equipment for the gravimetric determination of the dust content of air is recommended for adoption in research work. The gravimetric method must be retained in the future as the basic one, and at the same time work must be continued on its further improvement, in particular, its automation. 3) Along with the gravimetric method, in the practice of the work of institutes it is expedient to use in a parallel a counting method. Among the counting apparatuses, the most reliable data are given by VDK-4 apparatus, which however, must be further improved. The field aerosol counter for the determination of the concentration by count in the flow is recommended for use in the practice of hygiene research. The use of instruments for the determination of the concentration by count in arrested flow is not recommended. It is necessary to continue the work on the improvement of the counting methods for determining the dust content in air, along the line of automation of the particle count of dust and determination of its size distribution.

09107

Delange, J. E.

EVALUATING DUST ARRESTING EQUIPMENT ON LARGE COAL-FIRED STEAM GENERATORS. J. Air Pollution Control Assoc., 18(2):95-97, Feb. 1968. 6 refs.

The experience of The Detroit Edison Co. in conducting performance tests on dust arresting equipment on large stoker-fired and pulverized coal-fired steam generators is reviewed. The review includes the application of various test procedures and apparatuses. It also describes a special test apparatus in its present state of development and the test procedures involved. This equipment employs 'Null' sampling nozzles of the Van Tongeren design, ranging from 0.75 to 1.50 in. diam. The equipment has two distinct advantages over the presently available commercial devices: (1) it provides a means of approaching isokinetic sampling under adverse test conditions, and (2) the size of the collected dust sample is generally adequate for analysis under the new ASME Power Test Code 28, 'Determining the Properties of Fine Particulate Matter.' A critical review of experiences and practices is presented, standardization is proposed, and areas of further research and development are indicated.

09624

Johnson, Warren B., Jr.

LIDAR APPLICATIONS IN AIR POLLUTION STUDIES. Preprint, Stanford Research Inst., Menlo Park, Calif., Aerophysics Lab., ((21)) p., 1968. 14 refs. (Presented at the 9th Conference on Methods in Air Pollution and Industrial Hygiene Studies, Pasadena, Calif., Feb. 7-9, 1968.)

The utility of the lidar in air pollution investigations stems from its ability to remotely detect particulate matter in the atmosphere at ranges up to 10 km or more. The purpose of this paper is to review the main areas in which this instrument can be of use in air pollution research and control: (1) to observe the struc ture of surface-based mixing layers, (2) to measure the transport and diffusion of plumes and clouds of particulates, and (3) to determine smoke-plume opacity.

11193

C. W. Gruber

SOILING POTENTIAL - A QUANTITATIVE METHOD FOR MEASURING SMOKE FROM COAL COMBUSTION. Preprint, Cincinnati Air Pollution Control and Heating Inspection, Cincinnati, Ohio, (8)p., 1967. (Pre- sented at the Industrial Coal Conference, Lexington, Kentucky, April 12-13, 1967.)

The opacity of a visible smoke plume is due to the presence of huge quantities of sub-micron carbon particles which have little mass, and therefore, quantating the smoke plume by mass rate of emission is not practical. By drawing a sample of the combustion gases through white filter tape the resultant stain which depends upon the total surface area of the particles, can be evaluated by the absorption and scattering of transmitted or reflected light. The optical density of the sample so determined can be used to de fine a unit of measure, known as the Coh (for transmitted) or the Rud (for reflected) light. This paper cites the use of optical measurement for quantating the visible smoke plume in terms of 'soiling potential' per cubic foot of combustion gas or per pound of coal fired and makes reference to the measurement of the 'soil ing index' of the general atmosphere from dark colored sub-micron particles using a similar optical measurement. (Author's abstract)

11340

I.A. Singer, M.E. Smith

A SUMMARY OF THE RECOMMENDED GUIDE FOR THE PREDICTION OF THE DISPERSION OF AIRBORNE EFFLUENTS - (A.S.M.E.). Preprint, Brookhaven National Lab., Upton, N.Y. ((25))p., 1968. (Presented at the Symposium on Urban Climates and Building Climatology, Brussels, Oct. 15-25, 1968.)

Guide that reviews the important aspects of atmospheric dispersion and to assist in the practical assessment of typical industrial problems is presented. It is intended as a first approximation of simple situations in uncomplicated terrain, and it would be difficult to over-emphasize the danger of being misled by improper application of the equations presented. Many of the contributors are not fully convinced that current understanding of dispersion problems justifies the preparation of a simplified approach, and the user is cautioned to seek qualified advice whereever these first approximations indicate a problem, or whereever the environment appears to be complex. The emphasis is on ordinary, continuous stack emissions, and while other problems may be mentioned, none are treated fully. There has been no attempt to reference every significant work in the field of atmospheric dispersion, rather the bibliography contains material that should promote general understanding and lead to additional sources of information. The techniques suggested for the quantitative approximation of air pollution problems represent the most suitable now available.

11755

A. S. Denovan, R. W. Ashley

THE DETERMINATION OF OXIDES OF NITROGEN IN REACTOR LOOP COVER GAS. Atomic Energy of Canada

Ltd., Chalk River, Ont., Chalk River Nuclear Labs., ((11))p., Sept. 1967. 3 refs. CFSTI: AECL-2770

Procedures have been developed using selective absorbers followed by gas chromatography which are suitable for the separation and determination of NO and NO2 either from a bulk gas sample or directly from a flowing gas stream of CO2 containing up to 2% air. Nitrous oxides can also be determined if required. With synthetic gas samples, recoveries were shown to be quantitative using the procedures outlined. Calculations from data obtained for the procedures outlined. Calculations from data obtained for the preparation of calibration curves showed the standard deviations to be plus or minus 3.2 microgram for NO, plus or minus 2.6 microgram for NO2 and plus or minus 5.5 microgram for N2O over the range of 15 150 microgram. Limits of detection were 200 ppb for NO, 60 ppb for NO2 and 200 ppb for N2O.

11842

V. Vcelak

DETERMINATION OF THE DEGREE OF OXIDATION OF BROWN COAL BY MEASUREMENT OF LIBERATED HYDROCARBONS. ((Die Bestimmung der Oxydationsstufe von Braunkohle durch Nachweis freigesetzter Kohlenwasserstoffe.)) Text in German. Erdoel Kohl (Hamburg), 21(6):344-350, June 1968. (Presented at the 19th annual meeting of the German Society for Petroleum Science and Coal Chemistry, Hamburg, 5 Oct. 1968). 35 refs.

The presence of low-temperature oxidation in brown-coal mines is normally detected by the determination of CO and CO2 in the air. Experiments are now reported which show that even earlier stages of oxidation can be detected by determining the concentration of hydrocarbons (especially unstturated hydrocar bons) both in the mine atmosphere and adsorbed onto the coal. Samples of coal from several Czech coal mines were sealed in polyethylene under N2 and analyzed chemically and by gas chromato graphy. The degree of autooxidation of the sample was estimated in 3 ways: 1) from its ehcmical composition and the tar content following low-temperature coking; 2) from the course of degasification in the Brabender apparatus; and 3) from the hydrocarbons liberated from the coal during low-temperature coking or thermal decomposition. On this basis, the samples were classified into 5 groups: fresh coal (not oxidized), oxidized coal (but not yet glowing), ignited coal (glowing but not aflame), burned coal, and unoxidizable material. Whereas the amount of hydrocarbons (ethane, ethylene, propane, propylene and butane) liberated from fresh coal during degasification is negligible below 200 degrees C, but then increases rapidly with temperature, the amount liberated from oxidized coal shows two maxima, the first being a broad shallow maximum at about 150 degrees C followed by a minimum at 280 degrees C and then a rapid rise.

12126

Kitagawa, Tetsuzo, Yoshitaka Kobayashi, and Saburo Kanno

RAPID ANALYSIS OF SULFUR DIOXIDE IN FLUE GASES BY MEANS OF DETECTOR TUBES. Preprint, 20p., 1964 (?). 3 refs.

The use of detector tubes is described for rapidly determining the concentration of sulfur dioxide in flue gases from the combustion of coal or oil. The glass detector tube has an inside diameter of about 2 mm and a total length of about 130 mm. A constant amount of white detecting reagent particles is packed into each tube and stopped by cotton plugs. The detecting reagent is made by adding 100 ml of 0.2% potassium iodate solution to 100 g of silica gel particles. The color of the detecting reagent turns from white to orange by liberation of iodine by the reduction of iodate in contact with sulfur dioxide. Both ends of the tube are hermetically sealed. The total length of the packed gel plug is between 60 and 80 mm, depending on the inside diameter of the tube; the packed weight of detecting reagent in each tube is 0.25 g. The analytical apparatus for the method consists of a precision vacuum pump, the S02 detector tubes, antecedent tubes, a concentration chart, thermometer, suction pump, and a sampling tube attached to the wall of the flue. Each measurement from sampling to reading takes no more than 5 min. The measurable range of the method is from 0.02-03% S02.

12510

Dealy, James O.

SOURCE SAMPLING REQUIREMENTS FOR FOSSIL-FUEL-FIRED STEAM-ELECTRIC PLANTS. Preprint, National Air Pollution Control Administration, Durham, N. C., Div. of Abatement, 26p., May 1969. 10 refs. (Presented at the Rural Electric Generating Conference, 20th Annual, Denver, Colorado, June 2-5, 1969.)

Source sampling requirements for steam electric plants fired with fossil fuels are described in detail. Source sampling is divided into 4 main tasks: preliminary studies, actual testing, laboratory analysis, and preparation of a final report. Preliminary studies consist of emission factors, emission standards, test methods, location of a good sampling point, operating conditions of the plant, and the type and amount of fuel burned. The second task of source sampling begins with the transportation of sampling equipment to the test points. Before the actual test begins, one or more preliminary test runs are conducted. The information from the preliminary tests is used to adjust the sampling train in order to achieve accuracy when the actual test is performed. Power-plant source sampling processes are classified in two ways: sampling for gaseous contaminants, and sampling for particulate impurities. The testing for particulates and sulfur dioxide was discussed. In depth consideration was given to sampling procedures, sample train cleanup, and analytical techniques for determining the actual amount of sample collected.

13477

American Society for Testing and Materials

STANDARD METHODS OF LABORATORY SAMPLING AND ANALYSIS OF COAL AND COKE. In: 1966 Book of ASTM Standards, Part 19, Gaseous Fuels; Coal and Coke, No. D271-64, American Society for Testing and Materials, Philadelphia, Pa., 1964, p. 16-47. (18) refs.

Procedures for laboratory sampling and analysis of coal and coke ar presented. For determining the moisture of coal, an oven which has a uniform temperature in all parts and a minimum of air space shoul be used. For determining the moisture of coke, a drying oven with openings for natural air circulation may be used. Sulfur is determined in the washings from the oxygen-bomb calorimeter followi calorimetric determination. The determination of carbon and hydrog is made by burning a weighed quantity of sample in a closed system and placing the products of combustion in an absorption train after complete oxidation and purification from interfering substances. This method gives the total % of carbon and hydrogen in the coal as analyzed, and includes the carbon in carbonates and the hydrogen in the moisture and the water of hydration of silicates. In the determination of nitrogen, it is converted into ammonium salts. These salts are decomposed in a hot alkaline solution from which th ammonia is recovered by distillation and determined by alkalimetric or acidimetric titration.

There is no direct method of determining oxygen. It is calculated by subtracting from 100 to % of hydrogen, carbon, sulfur, nitrogen, moisture, and ash. Methods of preparing the laboratory samples for analysis are also presented.

14733

Elshout, A. J. and H. van Duuren

SO2 CONCENTRATIONS IN THE VICINITY OF POWER PLANTS. (SO2- Konzentrationen in der Umgebung von Kraftwerken). Text in German. Mitt. Ver. Grosskesselbesitzer, no. 107:119-126, April 1967. 19 refs.

The atmospheric SO2 concentration was measured at certain points in the vicinity of two Dutch tower plants (Harculo and Nijmegen). The T.C.M. method as described in the Ver. Deut. Ingr. guideline 2451 was used for the measurements. About 2000 individual measurements were taken. At the same time, cumulative sulfate measurements were taken according to the Liesegang method. The two power plants differed in their capacities as well as by their location in residential areas of different population concentrations. The maximum atmospheric SO2 concentrations were found in no instance to exceed the maximum allowable concentration of 0.75 mg SO2/cu m. The emission concentrations measured over longer periods of time were lower than the background concentrations. The maximum atmospheric SO2 concentrations computed according to the improved dispersion formula by Bresser and Hansch agreed with the actual measurements within a factor of 2. The SO2 concentrations computed with the Pasquill formula also agreed well with the measured values. Computation with the nomograms from the Technical Directives for Clean Air Maintenance taken from the Ver. Deut. Ingr. guideline 2289 yielded six times higher atmospheric SO2 concentrations than those actually measured. The measured distance of the maximum atmospheric SO2 concentrations from the emission source were on the average much smaller than the computed ones. The measurements showed that in the mathematical formulas, the horizontal and vertical diffusion coefficients are too low to render a true picture of dispersion conditions.

15348

Kolar, Joergen

STUDIES OF THE DISPERSION OF SULFUR DIOXIDE IN DENSELY OCCUPIED CITY AREAS WITH SPECIAL REGARD TO EMISSION FROM LOW SOURCES. (Untersuchungen ueber die Ausbreitung von Schwefeldioxid in dicht bebauten Stadtgebieten unter besonderer Beruecksichtigung der Emission aus niedrigen Quellhoehen). Text in German. Energie (Munich), 21(9):269-78, Sept. 1969. 28 refs.

To collect information on dispersion in densely populated areas, sulfur dioxide concentrations were measured in the stack and in the ambient atmosphere of a steam plant in central Munich. During the measurement period, Bavarian coal with 5% sulfur, as well as Saar coal or fuel oil, was burned. The flue gas volume and the SO2 concentration were measured 11 m beyond the exhaust blower. A quartz glass probe was used for sampling the flue gas. The analysis was performed with an electroconductivity analyzer. The sulfur dioxide immission was measured with a mobile electroconductivity analyzer. Measurements were taken between 10 a.m. and 5 p.m. The measurement points were selected in accordance with the prevailing conditions, i.e., with the wind coming from a constant direction at velocities of more than 2m/sec. The measurement program began in February 1962, but the most intensive investigations were carried out in the winter of 1965/66, with half hour measuring periods on the lee of the stack. A nearly log normal distribution of the SO2 immissions in the city area was found. The influence of interfering emissions and of the variation of the sulfur dioxide immission (mean standard deviation of 0.1 mg/cu m) are briefly evaluated. Preliminary measurement results are tabulated and shown in a diagram. The highest immission measured did not exceed the maximum allowable concentration of 5 mg/cu m.

15479

Gartrell, F. E. and S. B. Carpenter

AERIAL SAMPLING BY HELICOPTER. A METHOD FOR STUDY OF DIFFUSION PATTERNS. J. Meterol., 12(3):215-219, June 1955. 7 refs.

A method for studying atmospheric diffusion of stack gases is described which utilizes a continuous SO2 analyzer operated in a helicopter. The method was developed to overcome problems encountered in conventional diffusion studies at a large coal fired steam-electric power plant. It was tested by numerous sampling flights which demonstrated the practicality of the helicopter-analyzer combination for sampling for SO2 atmospheric pollution. Although the representativeness of samplings from a helicopter is not fully established, the effect of the helicopter on the quantities measured by the procedure outlined is believed to be negligible. As experience in use of this method is gained, this will be checked by comparisons with results obtained by conventional sampling procedures. With appropriate instrumentation, the method would be applicable to sampling for other atmospheric pollutants as well as SO2. The method has a number of advantages over conventional ground-sampling techniques, which make it particularly suitable for diffusion studies. These advantages include the rapidity with which down-wind sampling can be done, both aloft and near ground level, for considerable distances from the source; the greater accuracy with which the height and direction of the plume during the sampling period can be determined; and the ease with which otherwise practically inaccessible areas can be reached. The method provides information of a type heretofore unavailable and shows promise of being especially useful in diffusion studies. The analyzer has a threshold sensitivity as low as 0.1 ppm SO2. Response to changes in concentration is within 30 sec. The analyzer is calibrated approximately once a month, and the accuracy of SO2 determinations is within about 10%.

15515

FINAL REPORT ON FEASIBILITY STUDY FOR SENSING SULPHIDES IN COAL - 1968. Barringer Research Ltd., Rexdale, Ont., Canada, Contract PH86-67-270, Project 385, TR-68-55, 36p., Feb. 1968. 2 refs.

This report summarizes the work done in a feasibility study of a prototype monitor for sensing sulfide ores in coal, details laboratory experimentation, circuits and techniques, and gives the results of measurements. The principle employed in the monitor is the absorption of power by the conductive sulfide at radio frequencies. Sulfur content of interest was over 0.5-5% band at the normal operating frequency of 500 KHz. When circuit changes were made, signal-to-noise ratios improved, but the signals obtained were still very weak. Frequencies were increased to induce an increased loss into the very small particles of sulfide. It was found that even at 50 MHz with shielded coils, there was still no indication of power absorption into 5% sulfur coal. When frequencies were increased to the microwave region, coils became smaller and the coal samples were pulverized. Finally, with an abbreviated coil and grid dip circuit between 800 and 940 MHz, sharply increasing signals were obtained, which correlated with the sulfur sequence of the samples. For work at higher frequencies, the coil configuration was replaced with waveguide and cavity constructions. The frequency range of 500-1100 MHz was covered to check agreement with the grid dip circuit method. Qualitative agreement was evident and the coaxial cavity method showed acceptable differential signals over near zero to 5% sulfur samples even below 800 MHz. Another method was suggested which led to the construction of a flash heater or volatilizer, in which pulverized samples could be burned by a spectrometer to give a proportional indication of the sulfur content of the sample. Results with this method show very acceptable linearity over the range of interest. It is concluded that worthwhile follow-up work is indicated.

15925

SMOKE PLUMES FROM TALL STACKS. Stanford Res. Inst. J., no. 27:13-14, Dec. 1969.

The use of lidar to define plumes from tall stacks was discussed. An intense, narrow-beam, extremely brief pulse of light from a laser is fired into the atmosphere and is reflected to the lidar by particles of material in the path. The density and distance of particulate matter can then be determined from the character of the reflected signal. The tests were conducted on the plumes from an 800-foot stack of a coal-burning power station during two periods totaling 17 days in 1968. Measurements were made by scanning vertically at three azimuth angles. With the neodynium type of lidar used, the 20-30 measurements needed to probe each cross section of the plume were taken in 3 to 5 minutes. The data collected was reduced to the equal-density contours. These experiments demonstrated the practicality of the lidar as an instrument for use in air pollution measurement and monitoring. Plume tilting and fanning or spreading of the plume are common. There are significant vertical variations in stability and wind structure that have profound effects on plume behavior which are not taken into account by existing theories of plume rise. In addition to the application of lidar to pollution studies, lidar is well suited for defining cloud structure and dimensions of the pollutant clouds hanging over major cities.

16149

Arai, Kenya

THE OUTLINE OF ATMOSPHERIC TRACER FIELD TESTS IN THE WHOLE INVESTIGATION TO CONTROL INDUSTRIAL AIR POLLUTION. (Sangyo kogai sogo jizenchosa ni okeru ea-toresa jikken no gaiyo). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 3(3):150-156, March 15, 1967.

In Japan, atmospheric trace studies with fluorescent particles were first undertaken in the 1960's. In field tracer tests, special attention was given to determinations of wind direction and velocity, selection of test sites, and the location of test personnel, observation cars, and the communication system. Blowers were installed at heights of 105 to 192 m on power plant stacks in the survey area. The stacks were then sprayed and used as centers of fan-shaped sampling areas having angles of 40 to 90 deg and diameters of 10 to 15 km. Wind direction and velocity, air turbulence, temperature gradient, and the amount of sunshine were simultaneously observed. From these measurements graphs of diffusion distribution and stream line and charts of combined pollutant concentrations were obtained. Atmospheric tracer tests provide concentration distribution graphs for typical conditions of SO2 stack emissions. These distribution graphs are completed by comparison with measured sulfur dioxide at observation centers. Based on this data, instructions related to SO2 emission standards are issued to owners of plants or to local authorities by the Ministry of Industry and International Trade. Tracer studies also provide information for construction-site selection and city planning.

16364

Sachdev, R. N. and P. B. Rawlani

TURBULENCE STATISTIC STUDIES AT TROMBAY WITH A NEW WIND SYSTEM. J. Appl. Meteorol., vol. 7:981-985, Dec. 1968. 5 refs.

An electronic wind analysis system for turbulence studies near a nuclear reactor site was designed to compute the standard deviation of wind direction fluctuations from measurements of the accumulated value of the displacements of a wind vane during a predetermined interval and the number of reversals of wind direction during the same interval. Measurements are made with an optical encoder. The instrument can be adapted to study the variation of standard deviation from a few minutes to several hours. It can also be used for meteorological support when the standard deviation of wind direction fluctuations are required during a tracer release in diffusion experiments. Field studies indicate that the effects of nonstationary and local obstructions to wind flow make it impossible to estimate values of the standard deviation of wind direction fluctuations over uneven terrain on any one occasion. However, median values of observed standard deviations of wind direction fluctuations can be related to wind speed, wind direction, and time of day. The effect of local obstructions on the standard deviations is almost double in magnitude when the wind vane is downwind from an obstacle. A diurnal cycle in turbulence intensity is observed: the largest median values occur during late afternoon hours.

16512

Narjes, Ludwig

DUST SAMPLER EQUIPMENT FOR QUASI-ISOKINETIC SAMPLING BY MEANS OF NOVEL ZERO-PRESSURE PROBES. Chem. Age India, 19(8):595-603, Aug. 1968 9 refs.

In large power plants with steam generators fired by pulverized fuel, complicated dust problems often necessitate precise supervision of individual dust streams and local dust distributions The zero-pressure probe by which the static pressure of the main and sampling streams can be equalized is a suitable instrument for this purpose. The application of the probe for sampling high concentrations of dust in coal-dust streams and the behavior of the probe under diverse in-flow conditions in an inclined dust- conveying channel are presented. By evaluating the amount of dust at fixed points of the cross section, it is possible to investigate the distribution of dust density. The particle size analyses are converted according to the diagram of quantitative dust distribution and are entered on 'relative segregation' graphs.

16734

Ramsden, A. R.

A MICROSCOPIC INVESTIGATION INTO THE FORMATION OF FLY-ASH DURING THE COMBUSTION OF A PULVERIZED BITUMINOUS COAL. Fuel, 48(2): 121-137, April 1969. 26 refs.

Fly ash and partly burnt coal particles were collected from the gas stream of the combustion chamber and flue of a technical-scale pulverized-coal-fired rig during the combustion of a bituminous coal. The particles were examined as collected by means of an electron microscope. The observations were supplemented by the use of a light microscope to study particles of the raw pulverized coal collected before they entered the rig, devolatilized particles collected from the combustion chamber, and fly ash particles collected from the precipitator. Various stages in the combustion of the coal and the formation of the fly ash were observed. Carbon black formed at an early stage in the combustion process, presumably through cracking of volatiles. Many devolatilized coal particles formed carbonaceous skeletal structures, some formed vescular carbonaceous spheres. Many of the fly ash particles collected by the precipitator were glassy spheres, indicating formation from a liquid phase. Observation suggested that small droplets of liquid ash coalesced to produce larger droplets. An analysis of the particle-size distribution in the fly ash collected by the precipitator indicated the presence of large numbers of the smallest particles and successively fewer of the larger particles. Such a distribution might be expected where the larger particles were derived through coalescence of the smaller--the process having stopped as soon as the liquid particles solidified on reaching cooler parts of the furnace. (Author's Abstract)

16860

Brandon, John H.

CAN A FUEL TREATMENT PROGRAM CONTROL STACK EMISSIONS. Combustion, 41(4):20-24, Oct. 1969.

Stack emissions are not the major source of air pollution today, however, they do provide a measurable quantity of contamination that can be controlled. Four case histories of plants with representative problems are presented. The use of a blended slurry of the metallic oxides of aluminum and magnesium in a fuel treatment program resulted in a significant reduction in both SO3 and particulate matter. Reductions of 72.5% for SO3 and 76.2% for particulates were achieved with a marked improvement in the Ringelmann observations.

16875

McCaldin, R. O., L. W. Johnson, and N. T. Stephens

ATMOSPHERIC AEROSOLS. Science, 166(3703):381-382, Oct. 17, 1969. 3 refs.

Measurements of particle counts and size distributions of atmospheric aerosols have been made of various locations by use of an instrumented aircraft. The number of atmospheric particulates is related to the visibility. (Author's Abstract)

17419

Smith, J. F., J. A. Hultz, and A. A. Orning

SAMPLING AND ANALYSIS OF FLUE GAS FOR OXIDES OF SULFUR AND NITROGEN. Bureau of Mines, Washington, D. C., Report of Investigations 7108, 21p., 1968. 17 refs.

A series of studies of emissions from large coal-fired steam generators included measurements of the concentrations of sulfur oxides and nitrogen oxides in the combustion products. The mobile sampling equipment, method of sampling, and analytical techniques used for processing the samples are detailed. An adaption of the phenoldisulfonic acid procedure was used for the determination of nitrogen oxides. The Berk and Burdick procedure was first used for the determination of SO2 and SO3. This procedure is based on an acidimetric determination of bisulfite plus sulfate with independent determination of sulfate through benzidine sulfate precipitation. An interference, conceivably due to organic acids in flue gases from coal combustion, was found to give high sulfur balances. A modified process was therefore developed on the basis of the benzidine sulfate precipitation for both the SO3 and the total sulfur oxides content.

17468

SOURCES OF ATMOSPHERIC SULFUR DIOXIDES AND MEASUREMENT METHODS. (Taikic[illegible] no iousankabutsu no hasseigen to sokuteihoho). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(10):612-620, Oct. 25, 1969. 62 refs.

Atmospheric sulfur dioxide exists in various chemical and physical forms; under normal conditions, it is in a gaseous state containing some volatile sulfuric mist and sulfate. If gaseous sulfur dioxide were the only atmospheric pollutant, its measurement would not be so difficult. The existence of sulfuric mist and sulfate and other interfering substances in the atmosphere make analytical procedures intricate. Some difficulties in analytical assessment of atmospheric SO2 are also correlated with the limits involved in technical methods, some of which, like the West-Gaeke or electroconductivity methods, are subject to error due to the existence of atmaospheric interfering elements at variance with the substantial characteristics of SO2. Therefore, in evaluating measurements obtained from applied methods and laboratory techniques, allowance must be made for sequential and accidental errors. Atmospheric values obtained with the different methods are apt to vary. The widely used analytical procedure for SO2 determination involves separating mist from sulfuric mist and measuring the sulfur in the sulfate contained in the air sample. The quantity of SO2 is determined simultaneously with the measurement of suspended sulfate is an aerosol state or contained in dust fall. In 1965, the amount of sulfurous acid gas emitted to the atmosphere was 23,400,000 t. In 1966, the amount was 28,600,000 t of which 58.2% came from coal combustion in thermal power plants; 19.6%, from oil combustion; 5.5%, from petroleum refinery processes; 12.2%, from mine refinery processes; 1.9%, from sulfuric acid production; and the rest, 0.4%, from waste incineration. Various types of SO2 analyzers, including currently improved U. S. models, are presented.

17474

Kolar, Joergen

THE ELECTROSTATIC DUST MEASURING DEVICE 'KONITEST' AND ITS FUNCTIONING IN A REMOTE HEATING PLANT. (Das elektrostatische Staubmessgeraet 'Konitest' bei betriebsmaessigem Einsatz in einem Heizkraftwerk). Text in German. Tech. Ueberwach (Duesseldorf), 10(6):188-190, June 1969. 6 refs.

Control measurements were taken on an electrostatic dust measuring unit operation in a remote heating plant. The measurement probe had been installed in the stack 11 m above the exhaust blower. The speed in the probe was 1.5 times as high as the flue gas speed. The konitest and the dust filter were connected to the electrically heated sampling tube. A rubber hose lead to the blower. For weighing the dust quantity, a scale with an accuracy of at least 0.1 mp was used. The results of the measurements varied widely. In order to find an explanation for this, a steel pipe with a 12 mm diameter was inserted into the flue gas duct. The charges caused by the dust on the steel pipe were measured. The varying electric charges of the fly dust leaving the electrostatic precipitator caused the great divergence in the measured values.

18012

McCaldin, Roy O. and Louis W. Johnson

THE USE OF AIRCRAFT IN AIR POLLUTION RESEARCH. J. Air Pollution Control Assoc., 19(6):405-409, June 1969. 9 refs.

An instrumented single engine aircraft is being used to characterize plumes from large emission sources. The character and concentration of pollution as it ages and travels downwind under known meteorological conditions is being studied through the use of cross sections of the plumes at a number of points. This paper reports experimental work thus far completed on aerosol measurement. Flights have been made through plumes from a large coal-fired power station, forest fires, and a gravel plant. Particle counts in various size classifications were made with a Bausch and Lomb 40-1 Dust Counter which was carried in the aircraft. Selected meteorological parameters were recorded. Results show the aerosol concentrations in various size classifications that are found at successive distances downwind from these sources for distances up to 32 miles. Background aerosol concentrations are also reported, and variations in these can be noted with respect to time, location and altitude. (Author's Abstract)

19047

Vetter, H.

COMPARATIVE LONG-DURATION TRIALS OF DUST CONCENTRATION RECORDING INSTRUMENTS IN THE FLUE GASES OF BROWN COAL-FIRED POWER PLANTS. (Vergleichende Dauerbetriebserprobung von Staubdichtemessgeraeten hinter Braunkohlenfeuerungen). Text in German. Mitt. Ver. Grosskesselbesitzern, 49(1):23-27, Feb. 1969. 7 refs. (Presented to the VGB, Emissions Meet., Munich, 1967).

In three different soft coal-fired power plants, eight dust concentration units measuring the light extinction of three different manufacturers were tested for a period of three months. Gravimetric calibration measurements were taken at the beginning and end of tests. None of the units survived the test period without trouble or failure, and two instruments were entirely replaced after half the test period had elapsed. High deviations between the extinction and gravimetric measurements are explained by the varying grain size distribution of dust, its changing location, temporal changes of its surface properties, shape and density distribution, which consequently change the optical properties, varying water vapor content, and finally a low water vapor dew point. Causes for trouble such as the non-uniform soiling of the transmitter and reflector parts, as well as the formation of flue gas condensate in the transmitter and reflector casings, could be eliminated. The question whether extinction measurements are as reliable for soft coal-fired boilers as gravimetric measurements was not solved by the tests.

19519

Duewel, L.

RECENT ADVANCES IN RECORDING DUST MEASUREMENTS AT THE POINT OF EMISSION. (Neuentwicklung in der registrierenden Staubmessung au der Emissionsseite). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:193-198, 1970. 14 refs.

Recent types of measuring equipment tested and developed in large scale research for long-term, mass-production use are discussed, with special emphasis on light-transmission techniques, lightscattering techniques, and beta rays. The use of a light beam passing through dust-laden air lacks the disavantages that occur with the use of particle emissions. It has a special application in slag tap furnaces using soft coal. Improvements in this technique include an increase in the amount of scavenging air and structural improvements in its supply routes. The beta ray technique has been improved by an uninterrupted steam trace that extends to the extractor fan, also by an increase in the rate of flow through the extraction unit, which eliminates dust accumulation and condensations that used to occur. The use of additional control mechanisms now permits regular checking of the zero point and the sensivity constant.

20224

Boyer, A. E. and F. B. Kaylor

COMPUTER SIMULATES URBAN ATMOSPHERES. Power, 113(9):60-61, July 1969.

A new computer program named DOSAGE which analyzes the influence of power-plant emissions on the overall pollution picture was described. The program simulates the behavior of the city's atmosphere. Two groups of variables form the computer input; one for simulating the atmosphere, the other for defining the pollutant. Simulated variables consist of latitude, longitude, meridian, wind speed and direction, air temperatures, cloud cover, and ceiling. Pollutant input variables consist of stack gas flow rate, temperature at stack exhaust, pollutant concentration in the fuel, fuel fire rate, and collector efficiency. Although the program is tailored to work with sulfur dioxide emissions in the urban atmosphere, any kind of pollutant in any location can be treated. Results generated by the computer are generally within 10% of the measured values. The questions the computer program answers are where and how many hours peak concentrations occur each year, how the total annual duration of peak concentrations change if a pollution source is eliminated or controlled, how often a pollutant reaches significant concentrations at a specific point, and how the atmosphere is affected when load on a power plant is changed.

21663

Sandia Lab., Albuquerque, N. Mex.

CONTROL OF AIRBORNE CONTAMINATION. In: Contamination Control Handbook. NASA Order H-13245A, Section 5, 98p., 1969. 52 refs. CFSTI: NASA SP-5076

A detailed review of the facilities, equipment, and techniques for control of airborne contamination within a controlled environmental area is presented, with accompanying tabular summaries and diagrammatic illustrations. Contaminants are classified into major groups of organic and inorganic gases and aerosols, and major sources are noted. Control techniques are discussed in terms of devices for aerosols and gases, detection and measurement, and sampling. Types and selection criteria are given for air filters to be used in contamination control facilities, with a section on high-efficiency particulate filters. Nonlaminar airflow facilities (conventional clean rooms) are described, and the advantages and disadvantages of laminar airflow facilities outlined, with detailed descriptions of horizontal and vertical laminar airflow work stations. Temperature and humidity control, construction, furniture and equipment, and personnel garments for clean rooms are considered. A review of monitoring includes air sampling and collection methods, analytical methods and instrumentation, and filter bank leak testing. Specifications for laminar airflow clean rooms are considered at length.

22342

Schnitzler, Hermann, Otto Maier, and Klaus Jander

OBSERVATION POST FOR THE TESTING AND CALIBRATION OF INSTRUMENTS FOR THE MEASURING AND RECORDING OF DUST AND GAS EMISSIONS IN A POWER PLANT USING BITUMINOUS COAL. (Meszstand fuer die Pruefung and Kalibrierung von registrierenden Staub- und Gasmessgeraeten in einem steinkohlengefeuerten Kraftwerk).

Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 33:77-94, 1970. 11 refs.

Construction and use of an observation post behind the coal-fired generator boiler of a large power plant are reported. Accommodations are such that 4 dust-measuring devices and 4-gas measuring devices can be tested simultaneously. The plant is equipped with an especially good electrofilter, and the average dust content of the purified exhaust gas during normal operation is about 100-150 mg/cu Nm. Among the instruments tested are the Durag D-R 110, the Sick RM 3g (dust density measurements); the Konitest, which measures dust content; a Beta dust meter, which measures by way of beta-ray absorption. Two types of apparatus for measuring sulfur dioxide content by means of infrared radiation were the URAS, made by Hartmann and Braun, and the UNOR, manufactured by Maihak. Devices using ultraviolet light are the OKOMETER (by Withof) and UVAMETER (by Bran and Luebbe). Devices using chemical reactions for SO2 measurement are the Microgas MSK (Woesthoff) and the Color ADOS gas analyzer (Ados), a continuously operating colorimeter.

22391

Sakai, Kaoru, Fumio Mizuniwa, and Yasuji Hayashi

MEASUREMENT AND BEHAVIOUR OF EXHAUST GAS IN POWER PLANT. (Karyoku puranto haigasu no sokutei to kyodo). Hitachi Hyoron, 49(11): 1138-1142, Nov. 1967. 19 refs. Translated from Japanese. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 23p., Oct. 29, 1969.

In purifying exhaust gas in power plants, the development of desulfurizers and electric precipitators is being stimulated, but it requires a reliable method of analysis for gas ingredients. Mechanisms for the evolution of sulfur dioxide and sulfur trioxide are discussed. Volumetric methods for analysis of total sulfur, SO2 and SO3 include the neutralization process, the thorin process, and the arsenazo III process. Also discussed is the formation of nitrogen oxide and its measurement. Attempts to increase the reliability of methods for testing sulfur dioxide and trioxide, nitric oxide and nitrogen dioxide, and water are presented. The results of measurements in actual plants carried out according to the methods described or with a dew point indicator are summarized. Some observations on operating variables within the power plants are included. (Author abstract modified)

22511

Petersen, Helge

A TYPE OF WIND TUNNEL FOR SIMULATING PHENOMENA IN THE NATURAL WIND. Advisory Group for Aeronautical Research and Development, Paris (France), Rept. 308, 7p., Oct. 1960. CFSTI: PB-188340

A description is given of a type of wind tunnel specially suited for measurements of wind pressure on buildings, of shelter effects, and of smoke concentration from a power plant chimney stack or of the diffusion of radioactivity from an atomic power plant. The tunnel design is based on a new model-law for such experiments as realized by Dr. Martin Jensen. His idea was that close to the earth, the wind develops a turbulent boundary layer with a characteristic velocity profile. A model test to determine the height of power plant stack, carried out at the Hydro og Aerodynamisk Laboratorium, Lyngby, is mentioned. Finally, a preliminary comparison of the turbulence intensity in the model scale with that in nature is presented. (Author summary modified)

22882

Moore, A. S.

SAMPLING DUST IN THE BUREAU OF MINES COAL-FIRED GAS TURBINE. Combustion, 35(4):28-30, Oct. 1963.

An apparatus is described for sampling dust at the inlet of an experimental turbine that uses combustion gases from a coal-fired furnace. Erosion of turbine blades by dust entrained in the gases was a major difficulty, and accurate dust sampling was required to test the effectiveness of redesigned blades and gas path. The probe is a 1/2-in. I.D., type 316 stainless steel tube carrying a 1/2-in. I.D. sampling nozzle and leading to an external filter. It is coupled to a pitot-static tube, with both probe and tube protected by water jackets. Measurements will be made to determine total dust load, particle size, incidence and degree of particle segregation, and gas velocity. Gas velocities through the probe are maintained automatically at the isokinetic sampling rate by an air operated valve; temperature of the gas at the filter is maintained at 220-240 F. Methods and results are given of testing on a half-scale mock-up of the turbine inlet to insure the requisite continuous-operation 1500-hr capability of the system. The filter retained more than 99% of the dust; variation in gas sampling rates at the probe face was approximately plus or minus 1.5%. The system removed a sample representative by weight with an average deviation of plus or minus 6.4%, and was judged adequate in all respects.

22885

Cummings, W. G. and M. W. Redfearn

INSTRUMENTS FOR MEASURING SMALL QUANTITIES OF SULPHUR DIOXIDE IN THE ATMOSPHERE. J. Inst. Fuel (London), vol. 30:628-635, Nov. 1957. 5 refs.

Details of design and operation are given for an automatic recorder and a portable meter developed for measuring small quantities of sulfur dioxide in air. Both instruments are sensitive to 1 pphm SO2 in the range 0-50 pphm; the range can be extended by simple adjustment, although sensitivity will decrease proportionally. In the recorder, atmospheric SO2 is absorbed by a ½hydrogen peroxide reagent in a continuous counter-current absorption column, resulting in the formation of sulfuric acid in the reagent solution; the increase in conductivity of the latter is measured. It is intended for long periods of continuous operation on a fixed site. The portable meter can be used in a small car for rapid surveys in a particular area; it is non-recording and battery operated. Sulfur dioxide in the air reacts with a starch-iodine reagent in a counter-current absorption column. The amounts of light absorbed by the unchanged and the partially decolorized reagent are compared by photoelectric cells connected to a galvanometer. The cost of both instruments is low, they are reliable over long periods, and are easy to operate. They provide a more realistic assessment of SO2 pollution than conventional lead peroxide candles and daily volumetric estimations. Studies in progress using the devices are indicating that when the plumes from modern power stations reach the ground, the SO2 concentration in them is low.

22909

Ramsden, A. R.

APPLICATION OF ELECTRON MICROSCOPY TO THE STUDY OF PULVERIZED COAL COMBUSTION AND FLY-ASH FORMATION. J. Inst. Fuel (London), vol. 41:451-454, Dec. 1968. 7 refs.

A brief description is given of a probe and sampling technique for collecting particles from the gas stream of a pulverized-coal-fired test rig for direct examination by transmission electron microscopy without any intermediate stages of sample preparation. The samples were collected with a water-cooled probe located in a region of the combustion chamber where the gas temperature was about 1000 C. The probe consists essentially of three coaxial stainless steel tubes: the outer tube is a water-cooled jacket, the inner tube carries a sampling grid and a Pt/Pt-14% Rh thermocouple, and the intermediate tube acts as a carriage for the inner tube, which can be withdrawn to change the sampling grid. A light but adequate deposit may be obtained with a sampling time of 2 sec; 10 sec is about the upper limit. With a short sampling time, a quenching effect permits molten particles to be collected. Initial experimental observations made during combustion of some New South Wales bituminous coals are presented, including reproduction of magnified samples. The techniques described, together with electron diffraction studies of the inorganic crystalline constituents, are being applied to studies of combustion of pulverized-coal particles and fly-ash formation, which in turn are expected to be of value in relating the physical properties of residual fly-ash to the efficiency of electrostatic precipitation.

22982

Degtev, O. N. and G. M. Karagodin

THE ADVISABILITY OF USING CHROMATOGRAPHY TO DETERMINE UNBURNT GASES. Thermal Eng. (English translation from Russian of: Teploenergetika, 16(12):53-57, 1967. 19 refs.

The loss due to unburnt gases is determined by analyzing flue gases with a GKhP-3 or VTI-2 apparatus, or with chromatographic or titrimetric gas analyzers. The choice of method is governed by the required accuracy of determination as well as by the minimum loss reliably recorded. Errors in determination result from errors in gas analysis, in calculating flue gas volume, and in calculating the calorific value of the fuel. Expressions are derived for calculating the errors of determination for the different gas analyzers and for establishing with adequate reliability the recorded minimum value of the concentration of components under determination. Allowable errors of determination are also calculated for different types of fuel. Based on a comparison of these values with the errors of determination by the different methods, the preferred analyzer for each type of fuel is determined. Use of a chromatograph is recommended for anthracites and coals.

23096

Vittori, Ottavio

RESEARCH IN CHEMICAL COMPOSITION OF SOME FORMS OF ATMOSPHERIC PARTICLES. Chicago Univ., Ill., Dept. of Meteorology, NIH Grants RG-4521 and S-12(C), TN-5, 54p., Dec. 15, 1956. 16 refs.

Procedures are described for identifying the chemical composition and size of airborne particles. The basic technique involves the capture of the particles in a specially treated gel. Reagents in the gel produce a physico-chemical reaction known as the Liesegang reaction. The products of the reaction precipitate in the form of rings. Identification of the particles is made by one or more of three factors: the character of the pattern of the precipitate, the color of the precipitate, or its change of color. Tests were developed for particles containing the following substances: chlorides, soluble iodide, soluble sulfide, soluble ferrocyanide, soluble sulfates, nitrates, potassium ion, soluble silver, fluorides, lead and all heavy metals. Details are given for the preparation of the gels to be used for specific tests, and techniques for the capture of particles are discussed. (Electrostatic precipitation, impactor, and millipore filter). Experiments conducted to study the production of sulfate particles by the burning of wood or coal are discussed briefly, and a technique for the capture of small water droplets and analysis of the salt which may be dissolved in them is described. (Author abstract modified)

23121

Jacobson, Murray, Samuel L. Terry, and Dominick A. Ambrosia

EVALUATION OF SOME PARAMETERS AFFECTING THE COLLECTION AND ANALYSIS OF MIDGET IMPINGER SAMPLES. Am. Ind. Hyg. Assoc. J., 31(4):442-4 July-Aug. 1970. 8 refs.

Coulter counter techniques were used to determine the collection efficiency of the midget impinger for coal dust samples with isopropanol, ethanol, and water as the collecting fluids. Impinger samples are collected in water, different types of alcohol, or mixtures of alcohol and water. Air is drawn through a nozzle at about 70 meters per sec and strikes a plate 5 millimeters from a nozzle. Dust is trapped in the liquid and subsequently examined under a microscope. The collection efficiency of the impinger with the alcohols and water was approximately 95% and 68%, respectively, for particles 1 micron and greater in diameter, and 77% and 64%, respectively, when the particle size range was expanded to include particles down to 0.68 micrometer in diameter. When the midget impinger samples were analyzed by standard microscopic techniques, equivalent counts were not obtained for the two alcohols, indicating the effect fluid viscosity has on standard microscopic techniques. Samples counted in a controlled temperature chamber, using the microscopic technique, showing a change in count of 2.4% and 1.2% per degree centigrade for isopropanol and ethanol, respectively. (Author abstract modified)

23350

Stockton, Edward L.

CLEAN AIR MANAGEMENT IN ALLEGHENY COUNTY, PA. J. Sanit. Eng. Div. Am. Soc. Civil Engrs., vol. 96(SA 5):1211-1219, Oct. 1970. (Presented at the American Society of Civil Engineers Annual and Environmental Engineering Meeting, Chicago, Ill., Oct. 13-17, 1969.

In 1969, Allegheny County changed its air monitoring program from one of 30-day sample data from dustfall cans and sulfate candles to continuous ambient air measurement of air pollution. Of the projected network of 18 remote stations, two stations will evaluate the hill-valley relationship to air pollution concentrations near major industrial sources. Other stations will evaluate specific emissions from known industrial, transportation, and power plant sources. Data from fairly clean sites will provide information on background levels and reflect changes in pollution with corresponding meteorological changes. Sensors for the stations are being selected on the basis of known or anticipated emissions in the area, the number depending on the parameters to be measured and meteorological data desired. At the first station in the network, the following parameters are measured: sulfur dioxide, hydrogen sulfide, fine particulates, wind speed, wind direction, temperature, humidity, and solar radiation. Telemetered data from the sensors are processed by a computer which issues hourly printouts of five-min pollutant averages, five-min highs, the time when the high was reached, hourly averages, hourly highs, and real time recording of data. Programming is being expanded to process inspection data, emission inventory data, and simulation modeling. It is anticipated that the completed network of 18 stations will be operational in late 1960 or early 1971.

23377

Brookhaven National Lab., Upton, N. Y., Radiation Div., Brookhaven National Lab., Upton, N. Y., Analytical Chemistry Group, Brookhaven National Lab., Upton, N. Y., Engineering Div., and Brookhaven National Lab., Upton, N. Y., Meteorology Group

THE ATMOSPHERIC DIAGNOSTICS PROGRAM AT BROOKHAVEN NATIONAL LABORATORY: SECOND STATUS REPORT. 42p., Nov. 1969. 17 refs. CFSTI: BNL 50206

The Isotope Ratio Tracer Method provides a means of unambiguously tracing sulfur in the atmosphere. It is specific, and the tracer behaves exactly like the pollutant sulfur, since it makes use of sulfur already in a fuel. The method is nonradioactive and applicable to a wide range of problems. Each of the elements necessary for its implementation has been developed and is in routine operation. This includes means of efficiently collecting samples that are adequate in size and representative of both sulfur dioxide and sulfur trioxide from furnace systems and sulfur dioxide and sulfates from the air at ground level and aloft; methods and apparatus for quantitatively processing small samples in preparation for isotope mass measurements; and design, procurement, and operation of an isotope ratio mass spectrometer with high sensitivity. Techniques for using SF6 as a collateral tracer have also been developed. The IRT method can be applied both to problems in the physical tracing of sulfur, such as in stack plumes, and to studies of the chemistry of sulfur oxides in the atmosphere. Results are reported on investigations currently underway, including combustion studies in power plants, plume dispersion from tall stacks, and pollution patterns in a small city. (Author abstract modified)

24245

Morgan, George B., Guntis Ozolins, and Elbert C. Tabor

AIR POLLUTION SURVEILLANCE SYSTEMS. Science, 190(3955):289-296, Oct. 16, 1970. 20 refs.

Atmospheric surveillance is necessary to identify ariborne pollutants, to establish ambient concentrations of these pollutants, and to record their trends and patterns. Air pollutants may occur in the forms of gases, liquids, and solids, both singly and in combination. Gaseous pollutants make up about 90% of the total mass emitted to the atmosphere; particulates and aerosols account for the remaining 10%. Small particulates are of particular importance because they may be in the respirable size range and can contain biologically active elements and compounds. Furthermore, they tend to remain in the atmosphere, where they interfere with both solar and terrestrial infrared radiation. Gase and particulates may undergo a variety of reactions to produce secondary pollutants that are sometimes more toxic than the parent pollutants. This is particularly true in the case of photochemical smog. Pollutant concentrations are directly related to the density of industry and the use of fossil fuels for power and space heating Cities that have poor ventilation or frequent temperature inversion are plagued with air pollution episodes. States have the primary responsibility for atmospheric surveillance. Surveillance systems are usually established on a city or regional basis. The federal monitoring system is to provide a base of uniform data for verification of data from the various agencies and the quantify pollutants that are difficult or expensive to measure. Presently, the operation of most of the devices and analyzers used for measuring air pollutants is based on wet chemical methods. New techniques are needed in which solid-state or advanced sensing techniques, based on physical or physicochemical properties of pollutants, are used. A number of new instruments are being developed by the National Air Pollution Control Administration (NAPCA). In addition, NAPCA has automated and computer-interfaced some of its more sophisticated laboratory and field instruments. (Author summary modified)

24412

Rowe, D. R. and L. W. Canter

AIR POLLUTION: CAUSES, EFFECTS AND RESOLUTION. Public Works, 101(10):86-87, Oct. 1970.

Various modes of transportation account for 60% of the total pollutants, industry for 19%, generation of electricity for 12%, space heating for 6%, and refuse disposal for 3%. These pollutants can be classified as primary or secondary, i.e., those emitted directly into the atmosphere and those formed by reactions occurring in the atmosphere, or they can be classified as particulate or gaseous. Settling particulate matter can be easily determined with a dust fall bucket, suspended particulates with a Hi-Vol sampler, and their soiling index with a paper tape sampler. Monitoring gases is more complicated, though simple detector tubes with specific color changes can be used to determine whether a serious ambient air quality problem exists. The sun plays a major role in the production of secondary pollutants and of photochemical smog. Meteorology is also of prime importance in air pollution and has many applications in air pollution control such a plant-site location, city planning, zoning, stack height, and allowable emission rates. Conversely, air pollution can affect meteorological conditions, reducing visibility and solar radiation and increasing fog and precipitation. Control of air pollution requires establishment of air pollution criteria and air quality standards, followed by ambient air quality standards for particulates, gases, and odors and emission standards. Along with these steps must go enforcement, either by policing, tax incentives or a charge for using air.

25147

Debrun, G.

THE OBSERVATION OF AIR POLLUTION AROUND A LARGE E. D. F. THERMAL STATION BY MEANS OF CONTINUOUS MEASUREMENTS RETRANSMITTED TO THE STATION'S CONTROL ROOM. (La surveillance de la pollution atmospherique autour d'une grande centrale thermique E. D. F. ay moyen de mesureurs en continu avec retransmission en salle de commande de la centrale). Text in French. Preprint, International Union of Air Pollution Prevention Associations, 9p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington D. C., Dec. 6-11, 1970, Paper SU-24A.)

A summarized description is presented of the instruments used in France for gathering continuous information concerning atmospheric acidity from measuring stations spread over a large city or an industrial site, and for retransmitting immediately this informatio to a central observation station. A survey is included of the firs results obtained in the vicinity of a thermal station by utilizing such control networks which have as a main function the indicating of the times when the emission of polluting agents into the atmosphere should be reduced. Measurements are obtained through a device regulating the pH of a solution of hydrogen peroxide through which the air to be analyzed is sent. (Author abstract)

25231

Dams, Richard, Kenneth A. Rahn, Gordon, D. Nifong, John A. Robbins, and John W. Winchester

MULTI-ELEMENT ANALYSIS OF AIR POLLUTION PARTICULATES BY NONDESTRUCTIVE NEUTRON ACTIVATION. Preprint, International Union of Air Pollution Prevention Associations, 41p., 1970. 12 refs. (Presented at the International Clean Air Congress, 2nd, Washington D. C., Dec. 6-11, 1970, Paper CP-31E.)

A nondestructive and computer assisted neutron activation analytical procedure for the determination of up to 33 elements in air pollution particulates has been developed and tested in pilot studies of samples taken in and near the urban-industrial area of Northwest Indiana and Chicago. Samples are taken by drawing air through a clean filter or an impaction sampler so that the particle are held by a substrate which can be irradiated with neutrons and which does not thereby become radioactive. The procedure includes 2 or 3 neutron irradiations of a portion of the filter followed by spectrometric measurement of induced gamma radiation by means of a germanium-lithium detector and multi-channel analyzer. The data are recorded by magnetic tape and computations are performed largely by digital computer. In one test a 36-hour time series of 90-minute samples indicated that both meteorological and time- dependent source processes may influence concentrations of the elements determined. In another study, analyses of 25 samples, which were collected by filters simultaneously over a network including both urban and rural locations, indicated that some, but not all, elements have principal sources lying within the urban and industrial region. Generally, metallic elements associated with certain industrial operations were several times higher in the urba center than in the surrounding countryside, but elements common in soil materials and elements which may occur both as gases and as particles were more evenly distributed over the network. In the same region size fractions of particles were collected by cascade impactors fitted with polyethylene impaction surfaces. Systematic differences were observed over the radius range 0.1 to 10 microns where refractory metals, such as iron, aluminum, and the rare earths, were found on distinctly larger particles than elements such as zinc, arsenic, antimony, and indium where vapor condensatio in some high-temperature industrial sources is expected. (Author abstract modified)

25260

Smith, Nelson S., Jr. and George E. Fasching

ELECTROGASDYNAMIC APPLICATION TO DUST MONITORING. Preprint, International Union of Air Pollution Prevention Associations, 17p., 1970. 18 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper CP-19E.)

Electrogasdynamic principles were investigated at the basis for a continuous monitor for size and mass flow of dust in a stream of gas. A cylindrical monitor was developed consisting of a high velocity ionizing section that electrically charges the dust, a velocity-reducing diffusing section, and a metal charge-collecting section that is segmented to permit the measurement of four currents. For dusts of uniform size, segment currents were shown theoretically to be a function of dust size and concentration. Segment currents produced by different particle sizes interact, however, making the relationship invalid. To overcome this, equations for segments currents in terms of size and flow rate of fly ash were developed from an 18-test factorial experiment coverin mean dust sizes of 43, 104, and 143 micron and dust rates of 2, 8, and 14g/hr. At the test gas flow rate of 3.5 scfm, dust concentrations were 0.15, 0.59, and 1.03 gr/cu ft. Dust sizes and flow rates predicted from the equations were subsequently compared with segment currents for known sizes and flow rates of dust within the calibration range. Largest errors in sizes and flow rate for five tests were 20 and 85%, respectively. Further reduction in error and adaptation of the method to a practical system useful in air pollution control appears feasible. The method might be used to continuously measure fly ash in power plant stack gases and, if made portable, to monitor respirable dust levels in coal mines. (Author abstract)

25872

Walkenhorst, Wilhelm

RESULTS OBTAINED WITH A NEW METHOD OF DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION OF SUSPENDED DUST. (Ergebnisse nit einem neuen Verfahren zur Bestimmung der Teilchengroessenverteilung von Schwebestaub). Text in German. Staub, Reinhaltung Luft, 30(11): 458-465, Nov. 1970. 8 refs. (Presented at the Internationalen Staubtagung, Bonn-Bad Godesberg, West Germany, June 9-11, 1970.)

Fine-pore sieves made of aluminium oxide of an average pore size of 0.025 micron are used for collecting suspended dust in coal mines. Rock dust requires a frequency maximum between 0.1 and 0.2 micron because fine particles are more numerous than in the case of coal. Above 0.5 micron the distribution function can be approximated by an exponential function with exponent 2.4. This relationship is not valid for coal dust. Below 0.2 micron there is a steep slope in the distribution curve. The frequency maximum is about 0.2 micron. If the surfaces and volumes or masses of the respirable fine dust are calculated (5 micron equal to 50%; 7 micron equal to 0%), particles of a size up to 1 micron will amount to 2-4% of the total mass of the respirable portion. In contrast to this the surfaces amount approximately to 10-20%. The rock dust content of the respirable dust increases with decreasing particle size. Values of 80-85% are reached below 1 micron.

26139

Schulz, E. J., R. A. Duffee, R. I. Mitchell, and E. W. Ungar

A TRACER TECHNIQUE TO MEASURE DEPOSITION OF STACK EMISSIONS. Am. Ind. Hyg. Assoc. J., 21(5):343-349, Oct. 1960. 7 refs. (Presented at the American Industrial Hygiene Association, 21st Annual Meeting, Rochester, April 27, 1960.)

A liquid atomizing technique was selected to generate a tracer aerosol which has the same settling characteristics as those of the emitted material. The parameter having the greatest effect on the particle size of the resulting dried tracer is the concentration of the solution to be atomized; the particle size distribution of the tracer aerosols for this study was determined with a cascade impactor. Solutions of uranine absorb blue light between the wavelengths of 4400-5200 A and have a brilliant yellow fluorescence between 5100 and 5900 A. Emissions from 250 and 300-foot stacks at a power plant were used for this study, while observations of plume direction were also recorded. To accelerate the tracer tests, instead of utilizing impaction slides or dust-fall jars, samples of the emitted tracer were obtained at various locations in the sampling area by collection on 2-inch membrane filtes. Wind direction and velocity together with observations of plume direction are shown to aid in relating fly-ash concentrations obtained and the deposition rates calculated. Based on preliminary laboratory study to investigate uranine decomposition with temperature, it was found that uranine could be dispersed as a tracer at stack gas temperature up to 600 F without decomposition. It is mandatory that background fluorescence be determined in the area to be investigated, while with direct stack injection, losses of tracer in the stack must be determined for each application.

D. AIR QUALITY MEASUREMENTS

00657

M. Katz, H.P. Sanderson, R. D. McKay

EVALUATION OF AIR POLLUTION LEVELS IN RELATION TO STEEL MANUFACTURING AND COAL COMBUSTION IN SYDNEY, NOVA SCOTIA. Preprint. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-134.)

Study covers air pollution concentrations in Sydney, Nova Scotia, (an iron and steel manufacturing area). Dust-fall, soiling index, and sulfur dioxide measurement are covered. Tables and charts (as an appendix) delineate the results of the survey.

00858

R. Venezia G. Ozolins

INTERSTATE AIR POLLUTION STUDY - PHASE II PROJECT REPORT. II. AIR POLLUTANT EMISSION INVENTORY. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. May 1966. 54 pp.

An emission inventory was conducted 1963-1964 as part of the St. Louis East St. Louis Interstate Air Pollution Study. The Study covered an area of 3,567 square miles and included the City of St. Louis and the six surrounding counties St. Louis, St. Charles, and Jefferson Counties in Missouri and Madison, St. Clair, and Monroe Counties in Illinois. More than 95% of the population and almost all of the industrial activity are located in the 400 square miles of the centrally located urbanized part of the Study area. The pollutant emission data presented can be almost entirely atrributed to this urbanized portion of the area. Population density and land-use maps, which provide an excellent index to the areal distribution of most pollutant emissions, are also presented. The pollutants considered in this survey are those emitted in large quantities from a variety and multitude of sources dispersed throughout the area.

01790

A.N. Heller D.F. Walters

IMPACT OF CHANGING PATTERNS OF ENERGY USE ON COMMUNITY AIR QUALITY. J. Air Pollution Control Assoc. 15, (9) 423-8, Sept. 1965

The air quality of an urban area depends to a great extent upon the quantity and type of fuel consumed. Thus, a marked change in energy demand from 1960 to 2000 A.D. will affect the air quality of all of our urban centers. Interwoven with this potential effect is the anticipated influence of the change in type and quality of fuels, e.g., nuclear fuels, high sulfur coals, and a major modification in energy drived motive power, i.e., fuel cells, and the subsequent depletion of natural gas as an energy raw material. The current trend is to greater urban population densities, and it is estimated that by the year 2000 A.D., 85 percent of America's population will live on only 10 percent of thre land mass. To assess the potential impact of the energy demands for the next half century on air quality, particularly of America's urban centers, a review of current practices of combustion of coal, petroleum, and natural gas, and the potential effect on community air quality will be developed. To meet the impact of the interrelated changing patterns of population growth, urban developments, energy requirements and available sources, research needs on both a short and long term basis will be explored. (Author abstract)

02046

E. W. Gillham A. Martin, and F. R. Barber

SULPHUR DIOXIDE CONCENTRATIONS MEASURED AROUND A MODERN POWER STATION. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/10). pp. 185-7.

Sulphur dioxide concentrations have now been measured continuously for two years around a modern 1000 MW Power Station situated in a rural area. The facts from 200,000 recorder-hours of data are presented and previous findings are confirmed and extended. On a long-term basis, the ground level sulphur dioxide from the Power Station was only a small proportion of that from other sources. Measured concentrations have not risen to published critical dosage levels as a result of the contributions made by the Station. Modifications to methods of calculations are proposed to account for the short-term maxima and their positions. The modifications are also extended to apply to other Power Stations. (Author abstract)

02057

S. R. Craxford, M. Clifton, and M.-L.P.M. Weatherly.

SMOKE AND SULPHUR DIOXIDE IN GREAT BRITISH: DISTRIBUTION AND CHANGES. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VII/1). pp. 213-6.

Using data obtained in the National Survey of Smoke and Sulphur Dioxide for urban areas in Great Britain it is shown that there has been a steady fall in smoke concentration in the air since 1952 which runs parallel with the fall in smoke emission from the burning of coal. In London the fall in both concentration in the air and emission has been much more marked than in the rest of the country. A corresponding study of sulphur dioxide shows a slow decrease in the concentration in the air for the country as a whole in spite of a slow increase in emissions. In London the increase in emission has been greater but even so no increase in concentration in the air can be detected; if anything, there has been a very slight increase. For similar types of site, both smoke and sulphur dioxide concentrations in the North are very much greater than in the South (with the exception of sulphur dioxide at certain types of site in Londo(); an important factor in accounting for these differences is the much higher coal consumption for domestic heating per head of population, in the North as compared with the South. Another important factor in the case of sulphur dioxide is the different sulphur contents of the coals used in different parts of the country. (Author abstract)

02818

THE GOTHENBURG AIR POLLUTION STUDY 1959-64. Gothenburg Air Pollution Committee (LUG), Sweden. 80 pp., 1964

Gothenburg, like many other cities all over the world, has experienced an increasing air pollution problem associated with population and industrial growth. During the last decade the Board of Public Health in Gothenburg has followed with special interest the question of air pollution in the city. This study, the first of its kind in Sweden, was started in October 1959 with a general survey including monthly means of deposited matter and sulfur dioxide and daily means of sulphur dioxide and smoke. The purpose of the survey was to get a picture of the air pollution situation in Gothenburg forming a basis for comparisons with other places and a platform for more detailed air pollution measurements. This part of the study was finished in September 1962. It was considered necessary to complete the 3-year study with more specialized measurements. During Sept. 1962-March 1964 2-hour mean values of sulphur dioxide and daily means of total suspended particulate matter have been determined together with automatic recording of carbon monoxide. The latter is considered as an index of air pollution from vehicle exhaust. Measurements of daily means of sulphur dioxide and smoke have continued at one centrally located station. The study was directed by the Gothenburg Air Pollution Committee (LUG). Financial contributions were received from three Government Research Councils, one private scientific Fund, one Commercial Association and from the City Council of Gothenburg. (Author introduction)

02953

PROVISIONAL METHODOLOGY FOR COMPUTING ATMOSPHERIC DISPERSION OF WASTE ASHES AND SULFUROUS GASES FROM POWER STATION SMOKESTACKS. (Vremennaya Metodika Raschetov Rasseivaniya v Atmosfere Vybrosov (Zoly i Sernistykh Gazov) iz Dymovykh Trub Elektrostantsiy.) Teploenerg. (Translation pci 207, Documentary Information Rept. No. 20) (7) 89-92, July 1964.

Presented herewith is a translation of a Russian study. The method proposed is based on theoretical and experimental work carried out in the vicinity of a large thermal power station. It is valid for the calculation of dispersion of pollutants, determination of the necessary height of smokestacks, and for attaining normalized values of ground-level concentration of such pollutants. The report explains how to apply the formula defining maximum concentration and how to select the various factors involved. A graph is proposed which gives--in terms of maximum concentration at a given distance--the value of the concentration of pollutants at other points, and, finally, a method is described for calculating the minimum height of smokestacks compatible with the authorized limits of concentration of waste products in the atmosphere. Taking up a specific instance--that of a certain power station located in the Ukraine--an example is given of the practical application of this method in calculating the maximum concentration of noxious impurities at ground level.

02979

A. J. Elshout

THE MEASUREMENTS OF DUST AND GASEOUS AIR POLLUTIONS IN THE VICINITY OF AN ISOLATED POWER STATION. Staub (English TRANSL.) 25, (11) 37-41, NOV. 1965. CFSTI TT66-51040/11

Reports the results of dust precipitation measurements and sulphur dioxide measurements carried out for many years in the vicinity of a power station. Within a radius of 3 km the precipitated fly ash was only 3% of the total amount emitted from the power station. The measured values were in good agreement with calculated values. In contrast to this the measured SO2 concentrations were 50% higher or lower than the theoretical values. A higher value was obtained for the Cz value in Suttom's formula. The different methods for calculating the minimum stack height must be checked and adapted by adjusting the coefficients. (Author summary)

03431

G. B. Welsh.

AN APPRAISAL OF AIR POLLUTION IN HUNTSVILLE, ALABAMA. Public Health Service, Washington, D.C., Div. of Air Pollution. May 1963. GPO: 862-747

During the period 1950 to 1963, the population of Huntsville increased about 480%. This growth trend, which is expected to continue, favors higher pollution levels in the future unless adequate control measures are taken. Local meteorological factors tend to intensify the air pollution problem in Huntsville. During periods of adverse meteorological conditions air pollutants may be concentrated in the business district of the city. The southeastern portion of the United States, which inlcudes Huntsville, is subjected to a high frequency of low-level atmospheric temperature inversions and stagnating air masses. Both of these conditions contribute to accumulation of air pollution in Huntsville, especially during the months of the year when the space heating requirements are greatest. The atmospheric pollutants of primary concern is Huntsville are due to (1) the improper combustion of coal, (and oil to a lesser degree) for space heating and power generation in connection with residential, commercial and industrial usages; (2) burning of garbage and refuse at the dump and of refuse on the premises of commercial and industrial installations; and (3) dust from mineral processing activities. Pollutants of secondary concern are odors, gases, and solvent vapors from various industrial and commercial activities. In addition, emissions from motor vehicles should also be considered. Whule public complaints have been primarily directed at smoke and dust problems there are many other gaseous pollutants which add to the complexity and magnitude of the proboelm. Periodic incidents of reduced visibility are one apparent indication of air pollution problem in Huntsville. Measurements of air pollution that have been made to data are inadequate to define the nature and extent of the air pollution problem. Visual observations indicate that the primary problems probably are: (1) smoke from the improper combustion of certain fuels and burning garbage and refuse; and (2) dusts from the processing and production of building materials. There is no organized air pollution control effort in Huntsville at the present time. The zoning ordinance establishes specific uses for certain districts and provides performance standards for air pollution control in the Research Park District. If properly enforced the zoning ordinance should minimize the future intermingling of residential and industrial areas, a condition that usually intensifies local air pollution problems.

03432

D. M. Anderson, J. Lieben, and V. H. Sussman.

PURE AIR FOR PENNSYLVANIA. Public Health Service, Cincinnati, Ohio, Div of Air Pollution and Pennsylvania Dept. of Health, Harrisburg. Nov. 1961. 144 pp. HEW

This report is the culmination of a joint study effort of the Pennsylvania Dept. of Health and the U.S. Public Health Service which began in March 1959 and ended Nov. 1959. The objective was a comprehensive evaluation of the air pollution problems in Pennsylvania and a compilation of technical information which could serve as a basis for future planning and action. Basically the study consisted of an analysis of all available air pollution data and opinion, and the development of pertinent new data short of an actual air sampling program. The main sources of information were personal visits and interviews with local officials. All manufacturing industries and public utilities in the State employing 100 or more persons were contacted by letter; this amounts to about 10% of the total manufacturing establishments in the State (1959); 862 replies were received. More than 80% of the State's population was covered in the community (over 2500) surfey. All available air quality data were assembled and tabulated as concisely as possible. Data on control activities received special emphasis. The main topics include: Emission Sources, Dynamics; Air Quality; Biological, Physical and Economic Effects; Control Activities. There were at least 476 communities (1959) where, according to local officials, one or more air pollutants were found in objectionable quantities. About 83% of the population of the State was considered to be exposed to objectionable air pollution from time to time. About half of all communities with less than 10,000 population are included. The fraction increases with community size to the point where all communities of greater than 100,000 population are affected. Nearly 100 communities were believed to have major problems.

03514

ATMOSPHERIC POLLUTION IN THE GREAT KANAWHA RIVER VALLEY INDUSTRIAL AREA. West Virginia State Dept. of Health, Charleston, Bureau of Industrial Hygiene and Cincinnati Univ., Ohio, Kettering Lab. 1952. 184 pp.

The purpose of the survey was to (1) establish factual information as to the atmospheric pollution problem of the valley, (2) compare the present particle-fall load of the valley to that of a previous survey made by the Bureau of Industrial Hygiene, West Virginia Department of Health from June 1945 to December 1947 and (3) to determine the present or future needs of establishing an agressive air pollution control program for the area. The total daily load of particulate solid matter discharged to the atmosphere was found to be approximately 500 tons, derived mostly from burning or processing of coal; that of gases, fumes, and vapors, most of which are sulfur gases from the use of coal, amounted to about 370 tons. While the particulate matter (fly ash, etc.) can be controlled to acceptable levels through selection of coal and installation of collectors, it does not appear that there is any prospect of 'cleaning up' the valley completely, although there is evidence that much more can be accomplished by economical means. It is further indicated that even with a consistent uniform daily loading of the atmosphere with particulate matter, the ground level concentrations may vary greatly, depending upon meteorological conditions. The elimination of sulfur dioxide arising from the use of coal is an extremely difficult problem, since low sulfur coal is not obtainable locally in sufficient quantity, while chemical methods of control would be economically prohibitive at the present time. Odors, which are extremely annoying at times, have not been explained satisfactorily in many cases. Analytical methods of identification are not available except in a few cases, although special equipment might be valuable in identifying such contaminants. Greater assistance from industry is required to identify such materials, to determine their toxicity and to establish the quantities discharged into the atmosphere. Two episodes of eye irritation of fairly severe character occurred in 1951. While these were of short duration, they served to indicate that pollution in the valley, under adverse conditions, can cause demonstrable ill effects. (Author summary modified)

04116

W. W. Stalker, P. A. Kenline, and H. J. Paulus

NASHVILLE SULFUR DIOXIDE EMISSION INVENTORY AND THE RELATIONSHIP OF EMISSION TO MEASURED SULFUR DIOXIDE. J. Air Pollution Control Assoc. 14, (11) 469-74, Nov. 1964.

A detailed inventory of sulfur dioxide emissions was prepared as part of the Nashville Community Air Pollution Study conducted by the Public Health Service during 1958-59. The primary purpose of the inventory was to provide data for a study of the relationship between the emission of sulfur dioxide and measured ambient levels. The development of the inventory, data collection methods, and calculations are described. Ambient levels of sulfur dioxide were related to average emissions of sulfur dioxide in such a way (correlation coefficient = 0.81) that mean seasonal concentrations of atmospheric sulfur dioxide in square-mile areas could be predicted with fairly good confidence from a knowledge of sulfur dioxide emissions. For these long-period (average) predictions meteorological variables can be disregarded. On a square-mile basis, on the average, one ton of sulfur dioxide emitted per day produced a mean atmospheric sulfur dioxide concentration of 0.022 ppm, and 10 tons of sulfur dioxide per day produced a concentration of 0.067 ppm. (Author abstract)

05010

New York State Air Pollution Control Board, Albany. (July 1958.) 76 pp.

A REVIEW OF AIR POLLUTION IN NEW YORK STATE.

This report contains current knowledge of air pollution problems affecting New York State. Previous study results are summarized and more important factors influencing air pollution in the state are discussed. The nature and types of air contaminants , their effects, and the elements of air pollution legislation are considered. Study areas for future activities of the Air Pollution Control Board and priorities for action are proposed.

05260

S. Y. Shamirzayev, and D. K. Nurullayev

POLLUTION OF THE ATMOSPHERIC AIR OF THE CITY OF TASHKENT AND WAYS FOR ITS REDUCTION . (Aagryaznennost' Atmosfernogo Vozdukha Goroda Tashkenta i Puti Yeye Snizheniya.) Med. Zh. Uzbekistana (9), 20-5 (Sept. 1960). Usss. (Tr.) (Translated as JPRS 9863.)

The dust and gas suspension exceed the maximum permissible concentration, in various places, by 2 100 times. During the winter period approximately 15,000 tons of coal is consumed daily in the city and more than 80,000,000 cu m of flue gas and 600 tons of ashes are discharged into the air (the burning of 1 kg of coal liberates 5.5 cu m of flue gas at an average coal ash content of 20 percent). On the average 240 tons of oil is burned daily. There is discharged every hour 60,000 cu m of flue gas into the atmospheric air, or 1,500,000 everyday. Of the twenty samples tested for lead fumes, eight were found to have exceeded the maximum permissible limits; of the 30 samples tested for carbon monoxide, 14 exceeded the maximum permissible limits. Soot was found in 20 samples; in some of them the maximum permissible limits were exceeded four times. At other posts, carbon monoxide exceeds the maximum permissible limits 2 5 times (from 14 to 29 mg/cu m, at a norm of 6 mg/cu m); concentrations of lead, 12 to 13 times greater than the maximum permissible limit (at a norm of 0.0007 mg/cu m, samples were found to contain from 0.014 to 0.0096 mg/cu m). The concentration of soot exceeded the maximum permissible limits six times (content of 0.9 mg/cu m). In the area of the asphalt and bituminous plant the dust suspension in the air proved to be 52 times greater than the maximum permissible limit (26 mg/cu m was found at a permissible concentration of 0.5 mg/cu m); the suspension of sulfur dioxide was 80 times greater (40 mg/cu m instead of 0.5).

05428

M. Abe

AIR POLLUTION IN SAPPORO AND ITS SOURCES. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo) 4, (2) 1-10, July 1966. Jap.

Primary sources of air pollution in Sapporo are the burning of coal and oil. Pollution is severest in winter since 90.2% more coal and 79.8% more fuel oil is burned during that season. Coal is used mainly for domestic heating and oil for large industrial plants. The types of coal used and their sulfur contents are tabulated, along with soot-emission concentrations. Hourly, daily, and seasonal changes in SO2 concentration and soot fall out are tabulated for various areas of the city. Data on air pollution from automotible exhaust is also tabulated. Visibility during the winter between 7 and 10 A.M. and 4 and 8 P.M. is significantly reduced. Economic losses and citizens complaints are categorized.

05551

McMullen, Thomas B., Fensterstock, Jack C., Faoro, Robert B. and Smith, Raymond

AIR QUALITY AND CHARACTERISTIC COMMUNITY PARAMETERS.J. Air Pollution Control Assoc., 18(8):545-549, August 1968. (Presented at the 60th Annual Meeting, Air Pollution Control Association Cleveland, Ohio, June 11-16, 1967, Paper 67-26.)

Statistical correlations between all pairs of 16 selected air quality measurements and 13 selected community parameters for 66 standard metropolitan statistical areas have been calculated, tested for significance, and reviewed for meaningful relationships. Of special interest are the correlations between the sulfate fraction of suspended particulate matter and the use of sulfur containing fuels (r equal 0.66), between ambient sulfur dioxide and the use of sulfur containing fuels (r equal 0.85), between the lead fraction of suspended particulates and annual purchases of gasoline (r equal 0.71), and between vanadium in suspended particulates and the percent residual fuel oil used in a community (r equal 0.69). Several of these relationships are given more definitive description with mathematical equations that describe how the ambient pollutant concentration varies as a function of a related community parameter. The geographic distribution of high and low pollutant levels is also discussed.

06755

E. Effenberger

(DUST LEVEL MEASUREMENTS TO DETERMINE THE DEGREE OF AIR POLLUTION.) Staubkonzentrationsmessungen zur Ermittlung des Verunreinigungsgrades der Luft durch Korpuskulare Beimengungen. Beitr. Problem Luftreinhaltung (Essen) (68) 35-56, Nov. 1965. Ger.

Various aspects of the problem of dust in the air, its origin, effects and measurement are reviewed. Among the natural sources, forest fires and volcanic eruptions are mentioned. More important are manmade dusts deriving mostly from all kinds of combustion. The effects of dust on all forms of life are not completely known. Some occupational diseases like silicosis and other harmful effects of dust are described. The retention of particles of various sizes in the lungs is discussed. Results of large-scale health examinations in Prague are quoted. A section is devoted to particle size distributions and a typical example is quoted. Problems and methods of dust concentration measurements are discussed in detail. A large list of measuring equipment is given, both from Europe and the USA. In each case the principle of operation is noted and remarks pertaining to their practical use are added. Another section deals with the problem of how dust concentrations are correlated with dust fall measurements. Functional relationships between the two quantities, obtained experimentally, are plotted in several graphs and discussed in detail. Both concentration measurements and dust fall measurements bear a certain amount of statistical uncertainty. This, however, is not too objectionable since the effects of dust on humans can be classified only in three to five degrees at best. The article is concluded by 82 bibliographic references.

06777

(CHIMNEY PLUME RISE AND DISPERSION.) Elevation des Panaches de Fumees et Dispersion. Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1967.) 5 pp. Fr. (Rept. No. CI 316.) (C.I.T.E.P.A. Document No. 24.)

The symposium held at Letherhead, England on October 7, 1966 on chimney plume rise is reported which includes two surveys of the SO2 in the neighborhood of electric power houses and the chimney plume rise under various meteorological conditions. The height of the plume was measured in one case by the signal reflected from the plume of a luminous beam directed at the plume from the ground. The reflection is measured by a photoelectric cell on the ground. The use of lidar, which uses a laser beam instead of light permits the observation of an invisible plume 1200 meters from the source. It also detects the level of inversion. The lidar permits the total scanning of a plume in 3 min. The SO2 values for dispersion were made for different plume heights, but were not given. Two formulas were derived; one gives the height of plume of smoke and the other the maximum concentration at ground level.

06819

MEASUREMENTS OF STRONG ACIDITY IN THE AIR AND PARTICLES IN SUSPENSION ('BLACK SMOKE') PERFORMED BY E.D.F. SINCE 1960. ((Mesures de l'Acidite Forte de l'Air et des Particules en Suspension ('Fumees Noires') Effectuees par E.D.F. Depuis 1960.)) Text in French. Service de la Production Thermique, 4p., 1960. (Plus 95 maps, graphs, and charts, not included.)

Air was passed through filter paper and blown through water. The filter retained the dust and the water retained soluble gases, particularly SO2. The number of particles in suspension was determined by reflectometry. Charts give the amount of acidity in the air expressed in mg/cu m and the amount of black smoke (particles in suspension). Maps indicate the location of measuring equipment near the power stations. A series of graphs gives daily and monthly values of smoke and gas and sulfur emissions from power plants. The maximum allowable concentration of strong acid is 0.725 mg/cu m and of black smoke 0.350 mg/cu m. These values have never been exceeded by plants outside the urban areas.

06824

M. B. Jacobs

CONCENTRATION OF SULFUR-CONTAINING POLLUTANTS IN A MAJOR URBAN AREA. Proc. Symp. Atmospheric Chemistry of Chlorine and Sulfur Compounds, Cincinnati, Ohio, 1957 (1959). pp. 81-7. (Geophysical Monograph No. 3.)

The variation and concentration of the major sulfur-bearing pollutants; sulfur dioxide, sulfur trioxide and hydrogen sulfide are discussed. An examination of data concerning a large urban area indicates that there are five major types of variation in the sulfur dioxide concentration in the atmosphere. There is a seasonal variation with a high in December and January and a low in July and August. There is a diurnal variation with maximum generally in the period from 06h 00m to 10h 00m with a secondary maximum in the late afternoon or early evening. There is a variation specifically influenced by weather inversions with the highest concentration of pollution occurring with the more intense inversions which result with inversions starting at surface in combination with low wind velocity. There is a geographical variation as evidenced by decreasing concentration of sulfur dioxide as one moves from the center of the city. This is influenced by proximity to industrial areas. And there is a variation which is dependent upon movement of specific air masses. The sulfur trioxide concentration is generally low except for samples taken directly in plume of industrial plants. The concentration of hydrogen sulfide is generally low except in localized areas adjacent to sewage disposal plants and analogous situations. (Author summary modified)

07141

Dubrovskaya, F. I.

THE EFFECT OF SMOKE EMISSION PURIFICATION ON AIR DUST CONCENTRATION OF A LARGE CITY. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 1:118-121, Jan. 1960. (Also published in Gigiena i Sanit., 23(1):69-71 1958.) Translated from Russian. CFSTI: TT 60-21049

Over a period of several years the pollution of Moscow air was studied. The accumulated data presented the opportunity to determine the changes in air pollution intensity which resulted from the introduction of control measures. One of the basic measures was an official mandatory requirement that fly ash be removed from smoke gases emitted by electric power and heating plants and by boiler operated manufacturing and production industries. A comparison of the data under study with the value representing the limit of allowable concentration of dust in the atmospheric air of inhabited localities, shows that in most of the samples studied the dust concentration exceeded the maximal single limit of allowable dust concentration of 0.5 mg/cu m. Thus, despite considerable attainment in the fight against air pollution in Moscow, the condition of the air with regard to dust concentration failed to come up to the official sanitary requirement. Data regarding dust concentrations in different sections of the city during cold and warm weather, from 1946 1956, are presented in graphs.

07393

K. Nakayama

PRESENT STATUS OF AIR POLLUTION IN CITIES AND TOWNS. Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc.) (Toky/). 3(3):4-10, 1965. 12 refs.

A review of well-known air pollution episodes is given citing environmental conditions, damages, and causes for episodes in Meuse (Belgium) in 1930, Donora, Pa. in 1948, London in 1952, Mexico in 1950, Yokohama (Japan) in 1946, and Los Angeles at present. The present problems of air pollution in Tokyo are dealt with including dust fall, SO2 concentration, floating soot, dust, and hydrocarbons. The average value of dust fall was 23.46 tons/sq km/30 days for 1959 to 1963; the soluble elements of soot fall were measured at 6.47 tons/sq km/30 days. The maximum was recorded in 1961; seasonal measurements indicate a maximum in February and a minimum in December. Yearly variations of the quantities of coal and petroleum used between 1955 and 1964 indicate a relation between dust fall and the amount of coal used, but no relation between the latter and petroleum consumption. The distribution of SO2 gas concentrations in 1964 as measured by the lead peroxide method is shown on a map of Tokyo. Hydrocarbon concentration of C2 to C8 compounds ranges from 15 ppb to 1.5 ppm. In heavily trafficked areas the concentration of 3,4-benzopyrene is between 1.3 and 6.6 microgram/ 100 cu m. The effects of automobile exhaust from the gasoline engine are detected as high as 500 m. Also, water pollution from the Samida river causes ammonia and hydrogen sulfide to be discharged into the air.

07951

T. Suzuki, T. Okita, K. Iwashima, T. Monma, K. Tanaka , K. Fujisawa

SAMPLING AND CHEMICAL ANALYSIS OF TRACE METALS IN PARTICULATES AT AMAGASAKI, NISHINOMIYA AND ASAHIKAWA. Text in Japanese with English Abstract. Bull. Inst. Public Health (Tokyo). 16(1):1-14, 1967. 13 refs.

Particulates were sampled and trace metals in the particulates quantitatively analyzed. b8the metal content of coal smoke was also determined. Inorganic components of particulates were extracted from glass fiber filters and Be, Cd, Cr, Cu, Fe, Ni, Ti, and V were colorimetrically analyzed. The annual mean particulate concentrations in Amagasaki and Nishinomiya were 0.30 and 0.19 mg/cu m respectively and the concentrations in both cities varied quite similarly. The concentrations of Cr, Cu, Fe, Ni, Ti, and V in the air at industrial and business areas in Amagasaki were considerably higher than those in the air of American and British cities. Since the concentrations of metals, especially of Ni, and Ti, in the air of Asahikawa were low, it may be inferred that the metal content in coal smoke is usually low. It was found that Cr and Fe were released from widely distributed sources and that a large part of Cd, Cu, Ni, Ti, and V were released from speical sources.

08298

Marraccini, L., A. Spinazzola, G. Devoto, and S. Zedda

DISTRIBUTION OF SEVERAL VOLATILE TOXIC PRODUCTS WHICH ARE INDICATORS OF AIR POLLUTION IN THE CITY OF CAGLIARI. NOTE II. THE SULPHUR COMPOUNDS. ((Studio sul comportamento di alcuni prodotti tossici volatili quale indice di inquinamento atmosferico nella citta' di Cagliari. Nota II. I composti solforati (SO2, H2S).)) Text in Italian. Folia Med. (Naples), 49(8):580-589, Aug. 1966. 19 refs.

Monitoring stations were set up in 18 locations on streets, street corners, and piazzas of Cagliari. Measurements of the levels of sulphur dioxide and hydrogen sulfide were made from 8 A.M. to 8 P.M., from Dec. 1, 1965 to July 15, 1966. Selective samplers were placed 1.5 and 2 m above the ground; they sampled 60 1/hr of air each. The levels of SO2 ranged from 0.0370 to 0.0002 ppm, which is less than that observed in other cities. The SO2 level peaks at about 8-10 A.M. at some test locations and falls off during the day In other locations it peaks, although at relatively lower concentrations, during the middle of the day, or even in the evening. Domestic and industrial combustion of coal, diesel oil, and gasoline are believed to be the sources of the SO2. No H2S was detected except at one location, in front of a cemetery, where the level ranged from 0.0006 to 0.0016 ppm.

08858

Martin, A. and F. R. Barber

SULPHUR DIOXIDE CONCENTRATIONS MEASURED AT VARIOUS DISTANCES FROM A MODERN POWER STATION. Atmos. Environ., 1(6):655-677, Nov. 1967. 15 refs.

Data are presented on ground-level concentrations of sulphur dioxide measured at various distances from High Marnham Power Station during the period October 1965 to September 1966. The measurements include pollution from background sources around the area, as well as from the Power Station, and the results are compared with those of previous years. As before, most of the pollution arrived from the west during fumigations, probably from distant urban sources. The pollution in the area has decreased steadily since 1963, especially in stable conditions in winter, but this decrease is due, in part, to the decrease in the frequency of persistent fog situations over the same period. Short-term pollution from High Marnham alone was occasionally detected at sites between 1/2 and 17 mi (0.8 to 28 km) from the source. The details given extend those published previously. Information is given on concentrations recorded near the source in the summer, and on possible additive effects of power station contributions. (Authors' abstract, modified)

09591

Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control

NEW YORK - NEW JERSEY AIR POLLUTION ABATEMENT ACTIVITY: PARTICULATE MATTER. PHASE II. PRE-CONFERENCE INVESTIGATIONS. 206 p. Dec. 1967. ((15)) refs.

An investigation of particulate matter air pollution conducted in the New York New Jersey metropolitan area in 2966 and 1967 is reported. The report includes these topics: History of Abatement Action; Description of Study Area; Climatology; Project Design; Air Quality Data; Particulate Emission Inventory; Meteorological Representativeness; Impact of Particulate Pollution on Study Area; Summary of Particulate Air Pollution Standards, Criteria, and Objectives; Comparison of Current Levels with Standards or Objectives; Anticipated Reductions in Particulate Emissions; Conclusions and Recommendations of Interstate Air Pollution New York New Jersey Metropolitan Area, January 1967; Aerometry Operations and Techniques; Emissions Inventory Procedure; and Pollutant Measurement Data.

09984

Croke, E. J., J. E. Carson, D. F. Gatz, H. Moses, F. L. Clark, A. S. Kennedy, J. A. Gregory, J. J. Roberts,R P. Carter, and D. B. Turner

CHICAGO AIR POLLUTION SYSTEM MODEL. (SECOND QUARTERLY PROGRESS REPORT.) Argonne National Lab., Ill., ANL-ES-CC-002, 160p., May 1968. 18 refs. CFSTI: ANL/ES-CC-002

Primary emphasis was placed upon the acquisition of air quality, meteorological and emission inventory data; and on the development of computational tools and analytical methods required to process, store, retrieve and analyze this data. The most significant program milestone that was achieved was the completion of the air pollution master information system a set of linked computer programs designed to prepare and merge data files, to search out and retrieve information from these files, to perform statistical analyses and to display the results of computational studies and data surveys. This system is the basic tool required for the construction of the statistical SO2 dispersion model. A number of other significant milestones were achieved in the diffusion analysis, meteorology, emission inventory and optimal abatement strategy phases of the program. These include: a statistical study of the Hyde Park telemetry station air quality data; the completion of the St. Louis physical model development; the definition of preliminary meteorological, air pollution regime criteria; the acquisition, analysis and processing of a major segment of Chicago's power plant and industrial emission data and the construction of an air pollution incident simulation code for the optimal abatement strategy study. Details of these and other studies conducted in support of the Chicago air pollution system analysis effort are discussed.

10723

Berlyand, M. Ye.

THE CLIMATOLOGICAL ASPECTS OF INVESTIGATION OF ATMOSPHERIC CONTA- MINATION WITH INDUSTRIAL WASTES. In: Modern Problems of Climatology (Collection of Arcicles) (Sovremennyye Problemy Klimatologii). Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio, Translation Div., Con- tract F33657-67-C1455, TT8000039-67, FTD-HT-1338-67, p. 300-315 CFSTI, DDC: AD 670893

A discussion of problems in the consideration of climatic factors in calculating the dissipation of industrial wastes into the atmosphere is presented. Materials are analyzed from observations of atmospheric contamination over the territory of the USSR. A map of the average monthly values of total dust settling per day plua its inorganic component, as well as the values of concentra tion of inorganic dust for May 1965 is given. The ratio of the total quantity of dust to inorganic dust is generally two to three. The results of determination of meteorological characteristics aiding in the propagation of admixtures in the atmosphere are analyzed. 10823 Berlyand, M. Ye. THE CLIMATOLOGICAL ASPECTS OF INVESTIGATION OF ATMOSPHERIC CONTAMINATION WITH INDUSTRIAL WASTES. In: Modern Problems of Climatology (Collection of Articles) (Sovremennyye Problemy Klimatologii). Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio, Translation Div., Contract F33658-68-C1455, TT8000039-68, FTD-HT-1338-68, p. 300-315, CFSTI, DDC: AD 680893 ATMOSPHERIC INTERACTION, AIR QUALITY MEASUREMENT: Meteorology, Dustfall, Diffusion A discussion of problems in the consideration of climatic factors in calculating the dissipation of industrial wastes into the atmosphere is presented. Materials are analyzed from observations of atmospheric contamination over the territory of the USSR. A map of the average monthly values of total dust settling per day plus its inorganic component, as well as the values of concentration of inorganic dust for May 1965 is given. The ratio of the total quanity of dust to inorganic dust is generally two to three. The results of determination of meteorological characteristics aiding in the propagation of admixtures in the atmosphere are analyzed.

11525

E. J. Croke, J. E. Carson, D. F. Gatz, H. Moses, A. S. Kennedy, J. A. Gregory, J. J. Roberts, K. Croke, J. Anderson, D. Parsons, J. Ash, J. Norco, R. P. Carter

CHICAGO AIR POLLUTION SYSTEM MODEL. (THIRD QUARTERLY PROGRESS REPORT.) Argonne National Lab., Ill., 254p., Oct. 1968. 23 refs. CFSTI: ANL/ES-CC-003

A system analysis for air pollution in Chicago is reported. Meteorology, emission sources and air quality data are studied in relation to atmospheric dispersion studies. Emission inventories for sulfur dioxide are presented. The economics of abatement and control programs are discussed. Data are presented in forms of maps, graphs, charts and tables.

12496

National Air Pollution Control Administration, Washington, D. C., Bureau of Criteria and Standards

REFERENCE BOOK SUMMARY OF NATIONWIDE EMISSIONS. Preprint, 36p., 1969 (?).

Estimates for the year 1966-1967 of nationwide emissions of the five primary air pollutants, carbon monoxide, oxides of nitrogen, sulfur oxides, particulates, and hydrocarbons, are presented. Information is broken down by source category, urban and non-urban location, selected air quality control regions, and projected motor vehicle emissions. The accuracy of the estimates is varied due to incomplete information and inadequately defined emissions. Sources include motor vehicles, gasoline and diesel engines, aircraft, railroads, vessels, coal, fuel oil, natural gas, wood, solid waste disposal, primary and secondary metal industry, cement manufacture, oil refineries, chemical processing, paper manufacture, and feed milling. A summary of the methodology used to arrive at the estimated figures is presented.

13176

Merik, J.

DISPERSION OF AIR POLLUTANTS IN THE VICINITY OF VARIOUS INDUSTRIES. (Ausbreitung luftfremder Stoffe in der Umgebung verschiedener Werke). Text in German. Z. Meteorol., 20(1-6): 116-118, 1968.

The Hungarian State Institute for Hygiene conducts regularly scheduled air quality measurements in various industrial centers of Hungary which are located near residential areas. The program was started in 1953 and has been continued ever since. The air pollution concentrations measured near electrical power plants, chemical industries, cement factories, and blast furnaces are listed. The grid measurements are being taken mainly in the residential and rural areas close to these industries with respect to wind direction. It was found that the pollution concentrations reached values which far exceed the permissible limits. The presently valid regulations are considered too lenient. Air pollution control methods within the various industrial plants are urgently needed.

16237

Stone, G. N. and A. J. Clarke

BRITISH EXPERIENCE WITH TALL STACKS FOR AIR POLLUTION CONTROL ON LARGE FOSSIL-FUELLED POWER PLANTS. Preprint, Illinois Inst. of Tech., Chicago, 12p., 1969. 20 refs. (Presented at the American power Conference Annual Meeting, Chicago, April 1967.)

British experience in the use of tall stacks to control emissions from power plants in England and Wales is summarized. Factual evidence gathered during 15 years of routine monitoring surveys, sulfur dioxide surveys, and dispersion studies is presented in support of the effectiveness of tall stacks. In all plants, peak SO2 concentrations at any ground level point are transient and infrequent, and their magnitudes are accurately predicted. No meteorological situation has been encountered in which short-term peak concentrations are more than double those in neutral conditions. Hot plumes from tall stacks rise high in stable atmospheric conditions, making virtually no contribution to ground level pollution. Because plume rise is high, stable lower atmosphere layers frequently shield the ground surface. It is concluded that modern power plants with tall stacks can operate for extended periods without adding to the general pollution level of the immediate area. Similarly, all plants in a large geographical area can collectively operate without any detectable influence on the trend of ground level SO2 concentrations at remote areas. Chimney stack parameters at various fossil-fuel stations and the results of an 11-month recording of hourly-mean SO2 concentrations (pphm) from all sources and from one power plant station alone are presented in tables. The plant's short term and time-mean concentrations during winter and summer are also tabulated. A diagrammatic representation is included of plume dispersion under different conditions of atmospheric stability.

22591

Zhilin, P. N.

ATMOSPHERIC AIR POLLUTION IN LITHUANIAN CITIES. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:174-179, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

Results of an investigation of the air quality of several Lithuanian cities indicate that two electric heat and power stations, a cellulose-paper combine, and a sulfate plant are major contributors to air pollution. At 100 m and 300 m from one of the two power stations, dust concentrations were, respectively, 22 times and 35 times in excess of the allowable limits. The highest dust concentrations from the other station were found at a distance of 300 m; this may be due to the fact that the station's 99-m smokestack carries the ash farther before it begins to settle. Numerous complaints were received from residents living 300-499 m from the station. Influenza, pulmonary tuberculosis, and pneumonia occur frequently among children living in the area of the 99-m stack. The present investigation also disclosed an increase in serious respiratory disturbances in children residing near the cellulose-paper combine's new acid producing plant. Sulfur dioxide emissions from this plant exceed by 10 times the allowable concentration. It is recommended that the electric power plants be equipped with dust collectors and that sulfur dioxide emissions from the cellulose-paper combine be controlled by proper absorption equipment. It is further recommended that railroad transportation be electrified and that foundries and other industries emitting dust and gases be separated from populated areas by a sanitary clearance zone.

22812

Wohlers, H. C. and G. B. Bell

LITERATURE REVIEW OF METROPOLITAN AIR POLLUTANT CONCENTRATIONS-- PREPARATION, SAMPLING AND ASSAY OF SYNTHETIC ATMOSPHERES. (FINAL REPORT). Stanford Research Inst., Menlo Park, Calif., Contract DA 18-064-404-CML-123, S.R.I. Proj. SU-1816, 193p., Nov. 30, 1956. 82 refs.

A literature review of metropolitan air pollutant concentrations and of the preparation, sampling, and assay of synthetic atmospheres is presented. Measured concentrations of gaseous and particulate pollutants in the atmosphere, including sulfur dioxide, hydrogen sulfide, nitrogen dioxide, ammonia, formaldehyde, hydrocarbons, chloride, carbon monoxide, ozone, fluoride, hydrogen fluoride, carbon dioxide, gross particulates, and dust fall are tabulated. Calculated emissions from centers of population are presented for industrial and public processes, including combustion of coal, oil, and natural gas, incinerators, automobile exhausts, power plants, and metallurgical operations. Data on measured and calculated air pollution concentrations throughout the world are given. Methods for injecting pollution simulants into a test chamber, such as ozone generators and aerosol despensers, are mentioned. Sampling and analytical procedures are described for the particular problem of testing static atmospheres for bacteria. Sampling equipment consists primarily of an impinger preceded by a millipore filter. Analytical procedures include ultraviolet absorption, high volume sampling, glass fiber filters, and colorimetric, gravimetric, iodimetric, spectrophotometric, Saltzman, and electrochemical methods.

23326

Dotreppe-Grisard, N. and R. Noel

APPLICATION OF THE METHODS OF EXAMINATION AND ANALYSIS OF COAL AND COKE PETROGRAPHY TO THE STUDY OF INDUSTRIAL DUSTS. (Application des methodes d'examen et d'analyse de la petrographie des charbons et des cokes a l'etude des poussieres industrielles). Text in French. Ann. Mines Belg., no. 5:665-693, May 1970. 9 refs.

A study was conducted to evaluate petrographic techniques of examination and analysis in the identification and quantification of industrial dusts. Samples were obtained in the area of direct emission of a coking plant with the intention of having a precise knowledge of the composition of the sample before the analysis. Methods of sample preparation, microscopic examination, and quantitative analysis are described. It is concluded that the techniques of petrography provided satisfactory results in this study and can be readily adapted to other air pollution situations. Of particular interest with respect to its application in the area of a steel mill or coking plant is that it is possible to identify the stage of processing at which the pollutant was emitted. One of the results of the quantitative analysis was the determination that the plan, to have a precise foreknowledge of the sample composition, was to no avail. All samples showed a quantity of material characteristic of the metalworking factories that surrounded the area in which the coking plant was located. Results of sampling at the coking plant and in a nearby residential area are presented tabularly and discussed.

23356

Koerner, Hanns-Joachim

EFFECT OF SO2 POLLUTION IN THE VICINITY OF A POWER PLANT. (Immissionsbeaufschlagung durch Schwefeldioxid in der Umgebung eines Kraftwerkes). Text in German. Wasser Luft Betrieb, 12(11):705-708, 1968. 5 refs.

A systematic study of an area lying within a 3-mile radius of a heavy emission source is described. A network of measuring points was established, such that each square kilometer of the area would be represented. Sulfur dioxide concentrations in the atmosphere were sampled by the silica gel process from the summer of 1966 to the summer of 1967. Laboratory analysis consisted of reducing the absorbed SO2 to H2S and photometrically measuring the molybdenum blue reaction. The emission source was a power plant with a total output of 128 megawatts, where a large percentage of the particulate content of the waste gases is removed with an electrostatic filter and the waste gas is released into the atmosphere from a chimney 104 meters high. The plant is at an altitude of about 150 m above sea level, 4.2 km south of the center of a large city, on the southern edge of a basin bounded by a forest-covered plateau. Meteorological data are given and discussed. The data obtained is evaluated in terms of 2 statistical functions, one representing the upper limit of the scattering range of average values (sustained load), the other the upper limit of the scattering range of individual concentrations (peak load). The effect of wind direction and wind velocity on these two emission functions is discussed.

23957

Schiermeier, Francis A. and Lawrence E. Niemeyer

LARGE POWER PLANT EFFLUENT STUDY (LAPPES). Vol. 1. INSTRUMENTATION, PROCEDURES, AND DATA TABULATIONS (1968). National Air Pollution Control Administration, Raleigh, N. C., Div. of Meteorology, Rept. APTD 70-2, 410p. 1970. 12 refs. CFSTI: PB 194152

The Large Power Plant Effluent Study (LAPPES) was initiated in Western Pennsylvania to evaluate the extent and effects of air pollution resulting from the largest complex of coal-burning generating stations in the United States. During 1968 four series of field experiments were conducted in an area surrounding the Keystone Generating Station; these experiments consisted of ground-based and airborne plume measurements supported by extensive meteorological observations. Part 1 of this volume describes the topography and climatology of the generating station complex, the sulfur dioxide and meteorological monitoring equipment, and experiment operating procedures. Part 2 presents tabulations of plant operational parameters and air quality and meteorological data collected during 1968. (Author abstract)

25476

Public Health Service, Las Vegas, Nev., Southwestern Radiological Health Laboratory

PARTICULATE EFFLUENT STUDY. PHOEBUS 1B, EP-IV. 53p., April 1970. 6 refs. NTIS: SWRHL-46R

A study concerned with delineating the physical and chemical characteristics and possible hazards associated with release of particulate matter (greater than several microns in diamater) from the Phoebus 1B, EP-IV reactor run is presented. The reactor test was conducted at Jackass Flats, Nevada. The particle deposition occurred in a general northerly direction from the test cell. Particles were found out to 82 miles with the results indicating a decrease in deposition (particles/unit area) with distance to about the 2.5 power. The particle size distribution, of all the particles collected, is reasonably described by a log normal distribution with a geometric mean diameter of about 12 micron and a geometric standard deviation of 2.7. A breakdown of the size distribution to those particles 10 micron and above gave a geometric mean of 26 micron and geometric standard deviation of 2. The density of 8 particles (12 28 micron was about 11 g/cc. This density indicates an equivalent aerodynamic geometric mean diameter of about 40 micron. The majority of the particles found and studied were larger than an equivalent diameter of 10 micron the usual cutoff for lower respiratory tract penetration. A regression analysis indicated a decrease in particle size and activity with distance. Isotopic results showed a large degree of fractionation of the fission products found in the particles. Electron microprobe analysis indicated uranium, carbon, and oxygen to be present in most of the particles analyzed. Particles were transported into the off-size area. The resulting ground concentrations were about 1 particle/100 cu m or less and there was no known interaction of particles with people from the general population. Thus it is concluded there was no hazard to the public from the 'particulate effluent.' (Author abstract modified)

E. ATMOSPHERIC INTERACTION

00023

F. E. Gartrell, F. W. Thomas, S. B. Carpenter, F. Pooler, B. Turner, and J. M. Leavitt

FULL-SCALE STUDY OF DISPERSION OF STACK GASES (A SUMMARY REPORT) Tennessee Valley Authority, Chattanooga, Division of Health and Safety, and Public Health Service, Cincinnati, Ohio, Division of Air Pollution. Aug. 1964. 110 pp. CFSTI: PB 166679

During fiscal years 1958-1962, the Tennessee Valley Authority conducted an air pollution research project under the sponsorship of the Public Health Service. In this project, advantage was taken of unique opportunities for full-scale appraisal of dispersion of air pollutants from large coal-burning, steam-electric generating plants. Advantages offered for diffusion studies included: (1) large isolated sources where intermixture with extraneous pollutants is not significant; (2) complete plant operational data and emission rates; (3) sufficient fly ash emission to provide a visible plume aloft out to distances of 10-15 miles under meteorological conditions of special interest; (4) a helicopter equipped with special instruments for sampling and recording SO2 concentrations, as well as extensive auxiliary instruments; (5) tower-mounted meteorological instruments for providing basic information on wind and temperature parameters; and (6) computer facilities for data analysis. In addition to the primary studies to determine diffusion parameters, a limited investigation was made of plume rise or effective stack heights. An extensive investigation was made of the oxidation of SO2 in the atmosphere after emission from the stack. Oxidation was studied with ground-based facilities and also in the plume at various distances and travel times, and under various weather conditions. In the course of this investigation interrelationships among SO2, H2SO4, and fly ash also were studied.

00846

F. Pooler, Jr.

POTENTIAL DISPERSION OF PLUMES FROM LARGE POWER PLANTS. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. GPO: 822-190-3, HEW: 999-AP-16

Expected ground-level concentrations resulting from emissions from large power plants are discussed for three meteorological situations considered to be most likely to result in significant air pollution concentrations. These situations are (1) high wind; (2) inversion breakup; and (3) limited mixing layer with a light wind. Effects of increasing stack height are discussed for each situation. Numerical examples based on calculations included as an appendix are shown. (Author abstract)

01259

W. G. Cummings, M. W. Redfearn, and W. R. Jones

AIR POLLUTION BY SULPHUR DIOXIDE. PART 1: THE EFFECT OF LAND CONFIGURATION ON POLLUTION BY SULPHUR GASES. J. Inst. Fuel (London) 38, 391-405, Sept. 1965.

A survey of sulphur dioxide pollution was maintained for three years in the vicinity of Llynfi power station to study the effect of land configuration on the dispersion of flue gases from a power station situated in a valley. Observations were made with lead dioxide candles at sites distributed symmetrically around the power station and the actual sulphur dioxide concentrations were monitored by means of a C.E.R.L. automatic sulphur-dioxide recorder at one site on high ground. Results showed that the power station caused a measurable but very small contribution to the sulphur dioxide pollution already existing in the surrounding countryside and that the configuration of the land affected the plumes from the chimneys. This resulted in sulphur dioxide concentrations lower than expected on nearby high land. It is concluded that siting a power station in a valley does not necessarily cause increased sulphur dioxide pollution of high ground in the vicinity. (Author abstract)

01260

W. G. Cummings, M. W. Redfearn, and W. R. Jones

AIR POLLUTION BY SULPHUR DIOXIDE. PART 3: THE EFFECT OF INCREASED CHIMNEY HEIGHT ON GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE. J. Inst. Fuel (London) 38, 437-42, Oct. 1965.

The effect of increasing the chimney height at East Yelland power station from 127 to 172 ft was assessed by comparing the patterns and concentrations of sulphur dioxide pollution for high and low chimneys over a limited range of weather conditions. With the shorter chimney, the plume was affected by a turbulent zone near the power station building at wind speeds greater than about 19 ft/sec, whereas with the taller chimney difficulties were caused only with wind speed greater than about 26 ft/sec. The maximum ground-level concentration of sulphur dioxide close to the power station was also reduced from about 50 p p h m to about 25 p p h m within the limited range of weather conditions obtaining during the survey period. However, at wind speeds at which the plume was unaffected by the turbulent zone near the station building the patterns and concentration of sulphur dioxide pollution were not changed by the increased chimney height. (Author abstract)

01261

W. G. Cummings, M. W. Redfearn, and W. R. Jones

AIR POLLUTION BY SULPHUR DIOXIDE. PART 2: SULPHUR DIOXIDE CONCENTRATIONS DOWNWIND OF TALL CHIMNEY - THE DIVERGENCE OF MEASURED AND CALCULATED VALUES. J. Inst. Fuel (London) 38, 426-36, Oct. 1965.

During a fortnight's intensive survey, sulphur dioxide concentrations were measured downwind of Castle Donington Power Station. The patterns and levels of sulphur dioxide pollution were established for a number of weather conditions and compared with values calculated by means of the Sutton, Bosanquet, Priestley, and Lucas and Spurr formulae for gas diffusion and plume rise. Most measured and calculated values agreed to within a factor of three; this is considered to be reasonable considering the unknown meteorological factors obtaining during the survey period. The reasons for the divergence of measured and calculated values are discussed, and it is concluded that the easiest way of calculating the level and extent of sulphur dioxide pollution from a power station is to use Lucas and Spurr's plume rise equation, followed by a simplified Sutton diffusion equation provided the equations are modified to take account of turbulence caused both by meteorological conditions, and by the topography of the ground over which the plume passes. (Author abstract)

01934

R. A. Scriven

PROPERTIES OF THE MAXIMUM GROUND LEVEL CONCENTRATION FROM AN ELEVATED SOURCE. Atmos. Environ., 1(4) 411-419, July 1967. 5 refs. (Presented at the Symposium on Chimney Plume Rise and Dispersion, Oct. 7, 1966.)

Simple one and two layer models of the atmosphere are used to derive properties of the downwind position and height of the maximum in mean ground level concentration which can effect either the handling or the interpretation of field data. It is shown that this maximum is quite flat, implying that whilst the peak value can be found accurately its position will be subject to large errors. The effect of stable layers above the source are also discussed and it is indicated how much of the scatter in field results can be attributed to this cause. (Author summary)

02410

G.A. DeMarrais, G.C. Holzworth, C.R. Hosler

METEOROLOGICAL SUMMARIES PERTINENT TO ATMOSPHERIC TRANSPORT AND DISPERSION OVER SOUTHERN CALIFORNIA. Weather Bureau, Washington, D.C. (Technical Paper No. 54). 1965. 90 pp. GPO 0-733-760

The rapid growth of population and industry in southern California is causing an ever increasing demand for electrical power and eventually expanded use of nuclear energy. For this reason, the U.S. Atomic Energy Commission requested that the U.S. Weather Bureau compile and evaluate the available meteorological data pertinent to atmospheric transport and dispersion over southern California. The summaries in this report give an indication of the manner in which effluents move from one place to another and of the capacity of the atmosphere to reduce the concentration of effluents emitted into it. However, these summaries are not all-inclusive for any area in southern California. Meteorological phenomena show considerable variation within short distances, particularly over irregular terrain like that of southern California. The generalized pictures of the movement of air and the dilution capacity of the atmosphere presented herein are intended to provide data that may be useful for preliminary considerations in selecting nuclear reactor sites. Although some of these summaries may be used in evaluating community pollution problems, the particular interest of the Atomic Energy Commission is in discrete point sources and the summaries have been compiled and evaluated with that in mind. (Author introduction modified)

03251

DISCUSSION ON 'AIR POLLUTION BY SULPHUR DIOXIDE' 'PART 1: THE EFFECT OF LAND CONFIGURATION ON POLLUTION BY SULPHUR GASES' 'PART 2: SULPHUR DIOXIDE CONCENTRATIONS DOWNWIND OF TALL CHIMNEYS - THE DIVERGENCE OF MEASURED AND CALCULATED VALUES' 'PART 3: THE EFFECT OF INCREASED CHIMNEY HEIGHT ON GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE' BEFORE THE INSTITUTE, IN LONDON, 24TH NOVEMBER, 1965. J. Inst. Fuel 39, (305) 256-63, June 1966.

D.H. Lucas emphasized the importance of comparing averages only on an equal duration basis. Dr. A. Parker said that the lack of information about the occurence of temperature inversions was a drawback and that the land/sea boundary must have had an effect at East Yelland. C. Bosanquet stated that little information was given that would enable prediction of ground-level concentrations. Dr. G. Nonhebel thanked the authors for taking his advice to recalculate the ground-level concentration using the 1957 Bosanquet formula for plume rise. Dr. S. R. Craxford asked if allowances had been made for the effect of wind speed on lead dioside gauges. Prof. R.S. Scorer criticized the lack of an experienced meteorologist on the team. Dr. D.J. Moore advised that the efflux velocity and wind speed modify the 2 1/2 times rule. D.M.C. Thomas presented some relevant calculations. Mrs. M.L. Weatherley wondered if anyone thought of applying Davidson's work, relating to valleys. C.F. Barrett contended that dilution factors were deluding. D.H. Labdon suggested apportioning the g.l.c. to the separate plumes. The authors replied to all of these discussions.

03557

D. H. Lucas, D. J. Moore, and G. Spurr.

THE RISE OF HOT PLUMES FROM CHIMNEYS. Intern. J. Air Water Pollution 7, 473-500, 1963.

Measurements of plume rise at two Central Electricity Generating Board power stations have led to the formula alphaQ1/4/U where alpha is 4900 for one station and 6200 for the other. (U = wind speed in ft/sec; Q = heat emission in MW Zmax = plume rise in ft.) A number of other publications of measured results have been considered and shown to be in reasonable agreement with the formula, provided a correction is applied for the distance at which maximum plume height is measured. The results do not agree with any previously published theoretical formula, but the theory of Priestley has been considered and is shown to be capable of reconciliation with the measured results. It is shown that measured results of plume rise can be reconciled with measured results of ground-level concentration, provided there is a proper discussion of the relationship between short-term and long-term measurements. Further study is needed to establish the reasons for the variations in the experimental values of alpha. (Author abstract)

04033

F. E. Gartrell, F. W. Thomas, S. B. Carpenter, F. Pooler, B. Turner, and J. M. Leavitt

FULL SCALE STUDY OF DISPERSION OF STACK GASES (PART I. DIFFUSION IN INVERSION CONDITIONS). Tennessee Valley Authority, Chattanooga, Division of Health and Safety and Public Health Service, Cincinnati, Ohio, Division of Air Pollution. June 1965. 148 pp.

Beginning at daybreak, or sometimes before daybreak on days when inversions were forecast meteorological data were logged each 30-minute period, and pibal observations were made each hour. A small light attached to the balloon permitted nighttime observations. To conserve manpower and to permit more frequent observations, theodolite readings were dictated into a recorder. At daybreak the Titrilog was transferred from car to helicopter, and it and other instruments were checked. Following takeoff, horizontal flights were made to check temperatures at the bottom and top of the meteorological tower. The vertical temperature profile was determined by a prescribed flight pattern where temperature readings were taken at 100-ft intervals starting at about 500 ft above the top of the plume. Plant personnel was alerted by an intercom system to begin special coal and SO2 sampling at the approximate time that actual plume sampling was begun. Cross sections normally were begun at the 1/2-mile section and continued at progressively greater distance as time permitted before strong changes in thermal and wind structure occurred. Actual plume sampling time usually averaged about two hours. During this time cross sections were taken at about four selected distances downwind from the plant. In flight the observer recorded temperature and elevation data, marked the Titrilog chart for later identification of each plume transect, and entered other pertinent observations on the chart or voice recorder. After completion of plume transects, temperature soundings were repeated before the flight was terminated.

04034

F. E. Gartrell, F. W. Thomas, S. B. Carpenter, F. Pooler, B. Turner, and J. M. Leavitt

FULL SCALE STUDY OF DISPERSION OF STACK GASES (PART II. DIFFUSION IN HIGH WIND NEUTRAL CONDITIONS). Tennessee Valley Authority, Chattanooga, Division of Health and Safety and Public Health Service, Cincinnati, Ohio, Division of Air Pollution. June 1965. 77 pp.

Field instrumentation and procedures for high wind neutral conditions were similar to those used in the study of dispersion during inversion conditions. However, the aerial sampling plan was modified to facilitate definition of the more mobile plume. In most instances replicate flights were made across the plume at successively lower elevations from top to bottom of the plume. Near the plant where the plume was relatively narrow, SO2 distribution was determined in some instances by sampling along the plume centerline or x axis. Within a relatively short distance or travel time the plume was widely dispersed in both horizontal and vertical dimensions. This much larger plume section and attendant longer time required for sampling each section restricted maximum sampling distance to three miles from plant. Generally, SO2 concentration at this distance had diminished to such a low level that plume definition from recorder charts no longer was possible.

04035

F. E. Gartrell, F. W. Thomas, S. B. Carpenter, F. Pooler, B. Turner, and J. M. Leavitt

FULL SCALE STUDY OF DISPERSION OF STACK GASES (PART III. PLUME RISE). Tennessee Valley Authority, Chattanooga, Division of Health and Safety and Public Health Service, Cincinnati, Ohio, Division of Air Pollution. June 1965. 34 pp.

This project was concerned primarily with investigation of diffusion rates in a steam plant smoke plume. While detailed data were obtained on plume rise at the time of each field sampling operation, the extensive observations required for a study designed specifically to improve procedures for estimating plume rise were not a part of the project. However, it is recognized that reasonably accurate estimates of plume rise under various operational and meteorological conditions are required for useful application of the derived diffusion parameters. The data which were obtained on plume rise concurrent with diffusion studies are, therefore, presented. Also, observed values are compared with calculated values and limited analysis is made of interrelations with plume rise with meteorological and diffusion parameters. A sufficient number of observations were not made for useful evaluation of the relations among plume rise, plume direction, and stack alignment. Data on plume rise were obtained only in inversion conditions and in neutral, moderately high wind velocity conditions. All observations relate to the Colbert Steam Plant, for which design and operational data are presented.

05357

G. T. Csanady

SOME OBSERVATIONS ON SMOKE PLUMES. Intern. J. Air Water Pollution 4, (1/2) 47-51, 1961.

The plume at Tallawarra power station was photographed many times to obtain the mean position. The observations were plotted in terms of appropriate nondimensional variables and compared with the observations of Bosanquet et al., as well as the theoretical results of Priestley and Sutton. Within about 1500 ft. from the source good agreement with theory was found. The asymptotic plume height was found to be given crudely by the formula: Za=250 F/U(cubed), where Za is asymptotic plume height, U is wind speed, F is flux of fuoyancy, a variable proportional to heat flux. (Author abstract)

05702

F. A. Gifford, Jr.

ATMOSPHERIC DISPERSION CALCULATIONS USING THE GENERALIZED 0GAUS- SIAN PLUME MODE. Nucl. Safety 2(2), 56-9 (Dec. 1960).

Results of recent dispersion experiments have more and more often been presented in terms of the simple Gaussian interpolation form ula. Ther is a practical need for a group of special formulas based on the Gaussian interpolation formula. From a review of previous literature, formulas are presented which consider a volume-source, fumigation, crosswinds, long period concentrations, maximum concentrations and their distances from the source, cloud width, cloud height, deposition, washout, and radioactive dosage.

06373

S. B. Carpenter, J. A. Frizzola, M. E. Smith, J. M. Leavitt, F. W. Thomas

REPORT ON FULL-SCALE STUDY OF PLUME RISE AT LARGE ELECTRIC GENERATING STATIONS. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper No. 67-82.)

Plume rise data were collected at six coal-fired, steam- electric generating stations within the TVA system over a 2 year period. Unit ratings ranged from 172 to 704 megawatts with stack heights varying from 250 to 600 feet. An instrumented helicopter and special photographic equipment were used to obtain 1,580 separate plume observations and significant related meteorological parameters during stable, neutral, and slightly unstable conditions. The 1,580 observations were resolved and consolidated into 133 composite observation periods covering 30 to 120 minutes. Meteorological parameters and other compiled input data were entered into four principal equations for calculation of plume rise, and calculated plume rise values were compared with observed values. Most equations overestimated plume rise in low wind speed. For moderately high wind speeds, the ASME and Concawe equations gave best fit. (Authors' summary)

06775

M. Brun

(DIFFUSION OF POLLUTANTS IN THE ATMOSPHERE. METHODS OF CALCULATING THE HEIGHT OF INDUSTRIAL CHIMNEYS IN EFFECT IN GERMANY, UNITED STATES, GREAT BRITAIN, HOLLAND AND RUSSIA.) Diffusion des pollutants dans l'atmosphere. Methodes de calcul de la hauteur des cheminees industrielles en vigueur en Allemagne, Etats-Unis, Grande-Bretagne, Hollande, Russie. Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1967.) 31 pp. Fr. (Rept. No. CI 271.) (C.I.T.E.P.A. Document No. 24.)

A comparison is made of the methods of calculating the height of industrial chimneys in the various countries involved. In principle, all of the methods are applications of Sutton's dispersion formulas, although the choice of meteorological parameters may be made arbitrarily. Differences appear when the elevation of the plume is used rather than the actual height of the chimney. Different values for the permissible concentration at ground level adopted by different countries also causes a divergence. A comparison is given of the effect on each of the methods of the power of the installation, the sulfur content of the fuel, the velocity of the smoke at emission, the wind velocity, and the background pollution. Numerous tables are given comparing the different methods of calculation and the reasoning in back of them. THE HEIGHT OF INDUSTRIAL CHIMNEYS IN EFFECT IN GERMANY, UNITED STATES, GREAT BRITAIN, HOLLAND AND RUSSIA. Diffusion des pollutants dans l'atmosphere. Methodes de calculation de la hauteur des cheminees industrielles en vigueur en Allemagne, Etats-Unis, Grande-Bretagne, Hollande, Russie. M. Brun. Centre Inter- professionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1968.) 31 pp. Fr. (Rept. No. CI 271.) (C.I.T.E.P.A. Document No. 24.) ATMOSPHERIC INTERACTION: Stacks, Plume behavior, Diffusion models A comparison is made of the methods of calculating the height of industrial chimneys in the various countries involved. In principle, all of the methods are applications of Sutton's dispersion formulas, although the choice of meteorological parameters may be made arbitrarily. Differences appear when the elevation of the plume is used rather than the actual height of the chimney. Different values for the permissable concentration at ground level adopted by different countries also causes a divergence. A comparison is given of the effect on each of the methods of the power of the installation, the sulfur content of the fuel, the velocity of the smoke at emission, the wind velocity, and the background pollution. Numerous tables are given comparing the different methods of calculation and the reasoning in back of them.

06823

F. E. Gartrell, F. W. Thomas, and S. B. Carpenter

TRANSPORT OF SO2 IN THE ATMOSPHERE FROM A SINGLE SOURCE. Proc. Symp. Atmospheric Chemistry of Chlorine and Sulfur Compounds, Cincinnati, Ohio, 1957. (Geophysical Monograph No. 3.) (1959). pp. 63-8.

Information accumulated by the TVA on atmospheric diffusion was discussed. Difficulty in predicting ground-level concentrations of SO2 with the existing diffusion formula (Sutton) lead to the investigation of another method of smapling. The helicopter Titrilog sampling operation is being employed for defining the plume location, geometry and SO2 concentration. Meteorological parameters would be required in any formula designed to predict SO2 concentration at ground level some distance from the SO2 source.

06827

A. R. Meetham

THE BEHAVIOR OF SULPHUR DIOXIDE IN THE ATMOSPHERE. Proc. Symp. Atmospheric Chemistry of Chlorine and Sulfur Compounds, Cincinnati, Ohio, 1957. (Geophysical Monograph No. 3.) 115-21 pp. (1959).

In Britain, coal is the most important primary fuel, the amount of coal burnt in most regions is proportional to the population. The distribution therefore of the emission rate of sulphur dioxide is its mass per day per unit area, being approximately proportional to the density of the population. Through the activities of the Department of Scientific and Industrial Research, many observations have been made of the daily average concentration of sulphur dioxide in the air near the ground. Included among these are measurements of sulphur dioxide taken in a large town, in a densely populated area, and in a stable water fog. This paper sets out what may be inferred about the behavior of this pollutant from such knowledge of its emission and distribution in surface air. The speculations may be of value in the planning of controlled laboratory investigations and by suggesting new observations of the atmosphere and air pollution.

07428

H. A. Panofsky, B. Prasad

THE EFFECT OF METEOROLOGICAL FACTORS ON AIR POLLUTION IN A NARROW VALLEY. J. Appl. Meteorol., 6(3):493-499, June 1967.

The Air Pollution Division of Pennsylvania has conducted simultaneous measurements of meteorological variables and air quality at Johnstown, Pa. An analysis of the observations for two fall seasons showed that fluctuations in the concentrations can be expained fairly well by the changes in wind speed and fluctuations of vertical air velocities. Wind direction is relatively unimportant, except for the rare east winds, when the air at Johnstown is affected by a major steel plant. This paper presents a simple mathematical model that predicts variations in air pollution from a large number of low-level sources in a narrow valley. This theory is in good agreement with observations. It is likely that most of the pollution at Johnstown is locally produced. Since the situation of Johnstown is typical for that of many industrial cities, it is hoped that a study of the effects of meteorological factors on air pollution there will be useful for the understanding of air pollution characteristics of many similar sites.

07580

Zvinyatskovskii, Ya. I.

ATMOSPHERIC POLLUTION BY COAL-DRESSING PLANTS. (Zagryaznenie atmosfernogo vozdukha vybrosami ugleobogatitel'nykh fabrik.) Hyg. Sanit. (English translation of Gigiena i Sanit.) 30(9):438-440, Sept. 1965. CFSTI: TT66-51033/3

The nature and degree of atmospheric pollution were investigated in the neighborhood of two coal-dressing plants at Gorlovka, in the Donetsk Region. At both places the work is carried out on the gravity principle, by foam flotation in an aqueous medium. The wet coal concentrate is dried in special installations by the hot gases generatec by the combustion of the waste produced by coal dressing. Having passed through the drying installation, the drying gases are discharged into the atmosphere. The drying departments are equipped with dust-trapping devices, which free the issuing gases from coal particles. Plant No. 1 is equipped with three successive stages of dust-trapping devices: a cyclone, a multicyclone, and wet-dust separator. Plant No. 2, uses a multicyclone, thence through a V-shaped gas flue half-filled with water, into an apparatus which saturates the gases with water sprays. The department in which the concentrate is dried is the main source of atmospheric pollution with coal dust and gases. The concentrations of dust, sulfur dioxide, and carbon monoxide, as well as of the flotation reagents used for foam flotation, and of the synthetic alcohols and phenols which are the products of their decomposition. The samples were taken at distances of 300, 500, and 800 m from each plant, mainly on the leeward side, as well as in the presence of changeable winds. In all cases, determinations were made of the maximum one-time concentration. At distances of 300, 500, and 800 m from each plant, the one-time maximum concentrations of dust, sulfur dioxide, and carbon monoxide were considerably higher than the maximum permissible values. Sulfur dioxide and carbon monoxide concentrations at distances of 500 m from plant No. 1 were higher than at a distance of 300 m and became somewhat lower at a distance of 800 m. On the other hand, in the case of plant No. 1 the highest concentrations were found at a distance of 300 m, with successive decreases at distances of 500 and 800m. This agreed with the calculated values. The 300 m width of the sanitary protective zone is too narrow. Alcohols from flotation reagents were discovered in all samples, in concentrations ranging from 0.1 to 0.9 mg/cu. m.; phenols from flotation reagents were detected in 86% of all samples, in concentrations ranging from 1 to 7.5 mg/cu m. After the flotation reagents had been replaced alcohols and phenols were no longer detected in the air. The drying departments of the coal dressing plants were the principal source of pollution of the air around the plants with coal dust, sulfur dioxide, carbon monoxide and flotation reagents.

07801

Slawson, P. R. and G. T. Csanady

ON THE MEAN PATH OF BUOYANT, BENT-OVER CHIMNEY PLUMES. J. Fluid Mech., 28(2):311-322, 1967. 11 refs.

Plume-rise was observed by photographic means on smoke plumes from the Lakeview Generating Station (Ontario) and compared with some existing theoretical formulae. Supporting data in considerable detail on stack parameters were available. Source and environmental data for the eight experiments are summarized. Three experiments were carried out during neutral conditions. The observed plume paths in these three experiments are shown. A computer analysis of these three plume paths showed that the slope of each plume became constant (within the experimental scatter) beyond a certain non-dimensional distance, which was approximately the same in each of the three cases, although the slopes were individually different. There was thus a fairly definite transition point (or perhaps a short transition zone) at which the character of the plume changed. Between the chimney and the transition point, a non-dimensional plot of the three plumes coincided almost exactly, giving a 'universal' plume shape in the initial phase. In an unstable atmosphere the plume was sometimes above and sometimes below a corresponding plume in neutral conditions, under the opposing influences of increased dilution and the direct effect of instability in promoting plume rise.

07843

McLaughlin, J. F., Jr.

ATMOSPHERIC POLLUTION CONSIDERATIONS AFFECTING THE ULTIMATE CAPACITY OF A THERMAL-ELECTRIC POWER PLANT SITE. J. Air Pollution Control Assoc., 17(7):470-473, July 1967. 3 refs.

The power plant designer today has the tools at hand which enable him to predict with an adequate degree of accuracy the effect of different stack heights on ground level concentrations of the gaseous pollutants emitted from power plant stacks. Use of tall stacks will make it possible in most cases to build larger power plants at any particular site than are in service now and still operate them satisfactorily from the standpoint of air pollution. On the other hand, atmospheric pollution considerations may make it necessary at some sites to put a finite limitation on the maximum capacity that can be installed. (Author's abstract)

08400

K. J. Marsh, M. D. Foster

AN EXPERIMENTAL STUDY OF THE DISPERSION OF THE EMISSIONS FROM CHIMNEYS IN READING--I: THE STUDY OF LONG TERM AVERAGE CONCENTRATIONS OF SULPHUR DIOXIDE. Atmos. Environ. 1(5):527- 550, Sept. 1967. 7 refs.

The dispersion of sulphur dioxide in the town of Reading has been studied for a period of 15 months. Continuous measurements of the 6-hr average concentrations were made at forty sites in the area, and meteorological measurements were made for each 6-hr period. A detailed inventory was prepared of both domestic and industrial sources of sulphur dioxide. It is shown that, of various meteorological variables examined, the ambient air temperature has the predominant effect on the sulphur dioxide concentration in the air. The basis for the 'degree-day method' is confirmed in that the average concentration over the town increases linearly with the difference of the air temperature below a datum value of 15 Degree C. Isopleths of annual sulphur concentration have been drawn for eight wind directions; these show that the distribution of pollution is not greatly affected by wind direction although variations in the average air temperatures for different wind directions affect the general level. A pollution rise for the town as a whole shows that there is an excess of sulphur dioxide arriving from the east and this is attributed to pollution from London; some pollution also arrives from external sources in other directions. The annual average concentration of sulphur dioxide at individual sites is strongly correlated with the consumption of local installations emitting their effluents from chimneys less than 21 m high; an empirical equation is given for reading relating annual concentrations with consumption within 1000 m of the measuring point. Pollution rises have been drawn for each measuring site and these give a qualitative indication of the pollution from Reading, but a detailed comparison of individual vectors with the distribution of sources has failed to show a satisfactory correlation. The pollution rises do not indicate the larger industrial installations and it is considered that the chief contribution to the pollution in Reading is from domestic and low industrial chimneys. (AA)

09417

Price, James T.

CHIMNEY FLOW IMPROVEMENT. Power Eng., 7(9):52-55, Sept. 1967. 1 ref.

Deflectors can be used to produce satisfactory flow and also reduce draft losses. Colf flow air model studies of the Colbert Unit 1 and Bull Run Unit 1 are described to determine the effect of chimney geometry on plume rise characteristics. Addition of a vaned deflector to the 500-ft. Colbert Unit chimney resulted in elimination of eddies and reduction of chimney draft loss by 0.7 in. of water. In the 800-ft. Bull Run chimney, tests without hoppers revealed that the jets issuing from the breechings established an erratic spinning action in the chimney and that the alternating spinning motion was accompanied by random pressure pulsations which were reflected throughout the draft system. Use of a vaned deflector led to a reduction in draft loss of 0.3 in. of water. Without ash hoppers and without a deflector structure, this chimney was characterized by periodic pressure pulsations and flow was considerably more stable, but draft loss was increased by 0.1 in. of water. When the deflector was used without the hoppers, reduction in draft loss was 0.5 in. of water. Flow patterns differed radically for the two chimneys, although both were similarly shaped and effluent entered through the bases. For the Colbert chimney, four vertical eddies were formed, while for Bull Run the spinning -type flow developed. Studies of the effect of chimney outlet shape upon velocity and dispersion indicate that a cylindrical outlet produces a higher average velocity with less radial spreading than a venturi shaped outlet.

10010

Hino, Mikio

MAXIMUM GROUND-LEVEL CONCENTRATION AND SAMPLING TIME. Atmos. Environ., 2(2):149-165, March 1968. 27 refs.

The maximum or axial time-mean concentration of effluent generally decreases with increasing sampling time, because the lateral dispersion of effluent increases with increasing sampling time. Th rate of decrease in the maximum concentration with increase in sampling time is of practical importance for the abatement of air pollution. However, at the present time, no definite observational relationship seems to be established because of the larger scatter observational data and lack of reliable data with special emphasis this problem. On the other hand, theories by Inoue (1952), Ogura (1959) and Hino et al. (1966a) have indicated that the relationshi between the maximum of time-mean ground-level concentration Cmax an the sampling time Tau should be a -1/2 law i.e. Cmaxocr power law i.e. Cmaxocr 1/2. Field experiments on atmospheric diffusion of smoke from high stacks of thermal electric power stations were performed at three different locations. Concentratio distribution of effluent was determined by sampling cobalt sulphate particles and Freon-12 gas injected into the stacks as tracer material. Experimental data give support to the 1/2 power law. Finally, the data on diffusion summarized from other papers, togeth with the author's data are replotted to show that the above-mention relation fits most of the data for sampling time ranging from 10 mi up to 5 hr. (Author's abstract)

10053

Moroz, William J. and E. Koczkur

PLUME RISE AND DISPERSION NEAR THE SHORELINE OF A LARGE LAKE WHEN FLOW PATTERNS ARE DOMINATED BY THE LAKEBREEZE. In: Proceedings of the USAEC Meteorological Information Meeting held at Chalk River Nuclear Laboratories, September 11-14, 1967. C. A. Mawson (ed.), Atomic Energy of Canada Ltd., Chalk River, Ontario, Chalk River Nuclear Labs., AECL-2787, p.215-228, 1967. 10 refs. Available from: Scientific Document Distribution Office, Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada $12.00 per copy.

The rise and dispersion rates of the plume from a large thermal generating station located on the Lake Ontario shoreline in relatively flat terrain on the outskirts of a large city are examined under conditions where the local flow patterns are dominated by lakebreeze circulations. The plume was recorded for subsequent analysis using time lapse photographic techniques. Application of special films and filtering devices permitted observations to be extended beyond the point where the plume is no longer visible to the naked eye. Analysis of individual photographs is conducted using a photodensitometer to avoid error through the introduction of subjective interpretations. The position of the plume centerline in space and the vertical spread of the plume have been determined under conditions of moderate wind shear in the vertical and a slightly stable lapse rate through the layer of rise and dispersion. Tall stacks are used at the particular station observed and plume rise is enhanced by relatively large momentum and buoyancy forces. It is found that well above the surface, despite a strongly buoyant emission, within the lakebreeze circulation system rise and rate of dispersion of a plume in the vertical are less than would normally be predicted on the basis of ground level observation of meteorological parameters. (Authors abstract, modified) 1

10153

S. Brohult

THE SULPHUR PROBLEM AND AIR POLLUTION. ((Svavelproblem och luftfororeningar.)) Translated from Swedish. Annual Report of the National Academy of Engineers, Sweden p. 29-34, 1967.

Past and present sampling programs in Sweden show that content of sulfur dioxide in the air has increased considerably with a simultaneous increase in the proportion of sulfur in ionic form in precipitation. The result has been a marked invrease in acidity of rain water and in surface water. The levels of acidity in western Europe are discussed, and a map presents the average ann ual pH content of precipitation. The effect of low pH levels on soild and forest growth are discussed. The contribution of indus try to the pollution problem, and the efforts made to control pollution are also discussed. Recommendations are given for means of controlling the pollution, in Sweden, from sulfur com pounds.

10219

Gil'denskiold, R. S., B. B. Goroshk/, G. A. Panfilova and B. V. Rikhter

RESULTS OF EXPERIMENTAL OBSERVATIONS OF AIR POLLUTION IN THE RE- GION OF THE MOLDAVA THERMAL ELECTRIC POWER PLANT. (Rezul'taty eksperimental'nykh issledovanii zagryazneniya atmosfery v raioie moldavskoi GRES.) Text in Russian. Tr. Gl. Geofiz. Observ. (Leningrad), No. 207:65-68, 1968. 7 refs.

A previously proposed method for calculating the dispersion of fly ash and sulfur dioxide from smoke stacks of power plants was verifi by measurements made in the vicinity of the Moldava thermal power plant equipped with 180 m high, 6 m diameter stacks. The SO2 concentrations were measured at wind velocities from 2 to 6 m/sec a distances up to 9 km from the emission sources. Also, meteorologic parameters at the time of the measurements were determined. The maximum SO2 concentration calculated by a previously proposed formu amounted to 0.26 mg/cu m and the dangerous wind velocity to 2.5 m sec. The calculated and experimental values were in good agreement The height of the smoke plume above the stack was measured and correlated with the wind velocity. A previously proposed formula f calculating the smoke plume height was modified to give more accurate results.

10220

Goroshko, B. B.

SOME PECULIARITIES OF THE PROPAGATION OF POLLUTANTS FROM HIGH SOUR CES, DEPENDENCE UPON

SYNOPTIC-METEOROLOGICAL FACTORS.(Nekotory osobennosti rasprostraneniya vrednykh primesei ot bysokikh istochnikov v zavisimosti ot sinoptiko-meteorologicheskikh faktorov Text in Russian. Tr. Gl. Geofiz. Observ. (Leningrad), No. 207:69-7 6 refs.

Experimental data on SO2 concentrations obrained in the vicinity of a large thermal electric power plant with 100 m high stacks in t Shchekinsk region were processed to study relationships between meteorological conditions and air pollution. Graphs of SO2 ground concentrations up to 14 km from the sources were plotted under cyclone, anti-cyclone and intermediate conditions. SO2 ground concentrations at different distances from the sources were plotted as a function of temperature. Vertical SO2 concentration profiles versus temperature were also plotted at distances of 1, 2, 4 and 10 km from the source. Horizontal SO2 concentrations profiles as a function of wind velocity were obtained. The SO2 concentration on the ground was found to be at most only about 0.4 mg/cu m at a wind velocity of 0-2 m/sec, while at velocities of 3-6 m/sec it reached maximum of 1.8 mg/cu m at a distance of 4-8 km from the source. Th situation is explained by the effect of the wind on the direction o the smoke plume. Relationships between the turbulent transfer coefficient on the ground and the ground concentration were also studied. The ground concentration increased with increasing transf coefficient. Low transfer coefficients in winter were always accompanied by low SO2 concentrations. It appears that variations the transfer coefficient can be used for predicting air pollution.

10229

Selitskaya, V. I.

ANALYSIS OF AEROLOGICAL CONDITIONS OF AIR POLLUTION IN SOME REGIONS OF EUROPEAN RUSSIA. ((Analiz aerologicheskikh uslovii zagryazneniya atmosfery v nekotorykh raionakh ETS.)) Text in Russian. Tr. Gl. Geofiz. Observ. (Leningrad), No. 207:188-201, 1968. 5 refs.

Comprehensive measurements of meteorological parameters were made at altitudes up to 500 m. in the Moldava and Cherepetskaya power plant regions. Mean temperature, humidity and wind velocity profiles, pulsating velocity components, and temperature gradients were determined. The results indicate that the daily variations of all parameters are substantial. Further studies should be conducted to obtain data on nocturnal variations to permit evaluation of the intensity and size of inversion layers.

10368

Berlyand, M. E.

METEOROLOGICAL PROBLEMS OF CLEAN AIR PROTECTION. ((Meterologicheskie problemy obespecheniia chistoty atmosfery.)) Text in Russian. Meteorol. i Gidrol. (Moscow), 1967(11):50- 62, 1967. 11 refs.

Causes and control of air pollution in Russia are discussed, as well as research in air pollution. Cement dust emitted in 1964 alone amounted to 1.5 million tons. Large heat and electric power plants are presently installing ash collectors which are 95% effective, but even the small percentage emitted causes significant pollution because of the sheer volume of burned fuel. Desulfurization equipment is lacking. The effect of pollution depends on volume of emission, but more importantly on distribution of the pollutant and meteorology. Ground level temperature and wind velocity measurements are no longer sufficient since so many emission sources are high above ground (200-300 m.). Meteorological studies at the Main Geophysical Observatory are dealing with the first several hundred meters of air and include the development of mathematical equations for atmospheric diffusion from tall emission sources as well as formulas for initial escape velocity of pollutants and for pollution concentration. When an air layer with a weakened turbulence is directly superimposed over the emission source, the concentration of the pollutant more than doubles, while if such a layer is 100-200 m. above the source, the concentration is much less. Results of practical research conducted near the three heat and electric power plants with the tallest stacks in Russia during the period 1961 through 1965, using ground-level and air-borne equipment, agreed with theoretical data and led to the compilation of 'Provisional methods of determining the dispersal in the air of emissions from stacks of electric power plants' which is being applied in planning new power plants. Regular pollution determinations were started in 50 larger cities beginning in 1966, mostly using automatic recording equipment. Results of research in several large industrial cities of the Ukraine, Urals and Siberia have shown that air pollution is greater in cities with unfavorable meteorological conditions; in most cases, pollution is more severe in summer than in winter.

10421

S. B. Carpenter, J. M. Leavitt, Fred W. Thomas, John A. Frizzola, and Maynard E. Smith

FULL-SCALE STUDY OF PLUME RISE AT LARGE COAL-FIRED ELECTRIC GENERATING STATIONS. J. Air Pollution Control Assoc., 18(7):458-465, July 1968. 9 refs.

The plume rise research project conducted by TVA under sponsorship of the U. S. Public Health Service is discussed. Plume rise data were collected at six coal-fired, steam-electric generating stations within the TVA system over a 2-year period. Unit ratings ranged from 173 to 704 Mw with stack heights varying from 250 to 600 ft. An instrumented helicopter and special photographic equipment were used to obtain 1580 separate plume observations and significant related meteorological parameters during stable, neutral, and slightly unstable conditions. The 1580 observations were resolved and consolidated into 133 composite observation periods covering 30 to 120 min. Meteorological parameters and other compiled input data were entered into four principal equations for calculation of plume rise, and calculated plume rise values were compared with observed values. Most equations overstimated plume rise in low wind speed. For moderately high wind speeds, the Carson and Moses and the Concawe equations gave best fit. (Authors' abstract, modified)

10608

Gary A. Briggs, Isaac Van der Hoven, Rudolf J. Engel- mann, and James Halitsky

PROCESSES OTHER THAN NATURAL TURBULENCE AFFECTING EFFLUENT CONCENTRATIONS. In: Meteorology and Atomic Energy 1968, David H. Slade (ed.), Environmental Science Services Administration, Silver Spring, Md., Air Resources Labs., p. 189-255, July 1968. CFSTI: TID 24190

A number of processes other than natural atmospheric turbulent diffusion can be significant in the fate of radioactive material emitted into the atmosphere. First is the effect of momentum and buoyancy due to the mode of emission. Thus, for example, the forced emission of a hot effluent from a stack will cause the plume to rise, depending on both the plume and the ambient-air characteristics. A second process is the surface deposition of airborne material composed of either particulate or gaseous matter with resulting depletion of the airborne cloud and quasi-permanent residence of material upon ground surfaces. In the case of radioactivity, surface deposition creates a fixed source of radiation exposure with its cumulative effect as opposed to the rather transitory effect of the airborne cloud. The mechanisms causing deposition are numerous and often not well understood. These include gravitational settling (fallout), precipitation scavenging (washout, snowout, and rainout), surface impaction, electrostatic attraction, adsorption, and chemical interaction. A further complication is the possibility of resuspension and redeposition of material. A third process is the modification of the natural flow by solid boundary constraints ranging from a building or complex of buildings to the topographic constraint of hills and ridges. The law of conservation of fluid mass states that the fluid must flow around or over the obstruction and that there will be subsequent changes of speed, pressure, and streamline configuration.

10751

Hoegstroem, Ulf

A STATISTICAL APPROACH TO THE AIR POLLUTION PROBLEM OF CHIMNEY EMISSION. Atmos. Environ., 2(3):251-271, May 1968.

A method is described that not only gives one single concentration value but the expected concentration frequency distribution at an arbitrary point in the vicinity of the emitting chimney. The concentration frequency distribution obtained comprises the full range of meteorological conditions at a given place. In making the principal mathematical formulation of the method no assumptions whatsoever are needed about the mechanism of dispersion. In the practical application on the other hand, full use is made of the detailed knowledge of the dispersion process. First a 'basic case' is treated, the chief characteristics of which are: isolated stack, situated on a flat surface of uniform roughness; sampling time about an hour. The following information is found necessary for solving a concrete problem of this kind. (1) plant data, viz. rate of emission, gas volume and temperature, chimney height and exit diameter; (2) geographical site data, viz. roughness length; (3) meteorological data, viz. wind direction frequencies and statistics of 'dispersion categories' (stability and wind speed). Applicable formulae are discussed and also how statistics of 'dispersion categories' can be obtained by evaluating data from radiosonde stations. Certain deviations from the basic case are also treated in some detail; limited mixing height, the effect of large heat content on the dispersion parameters, the effects of buildings and topography, ground level release and sampling times other than an hour. A thorough test of the described method is presented. Nine months statistics of 2-hr SO2 concentration (2602 values) measured at a point situated 750 m from a sulphuric acid plant are compared with theoretically obtained statistics. The results strongly supports the method presented.

11065

E. J. Croke, J. E. Carson, F. L. Clark, A. S. Kennedy, J. J. Roberts

CITY OF CHICAGO AIR POLLUTION SYSTEM MODEL. (FIRST QUARTERLY PROGRESS REPORT.) Argonne National Lab., Ill. and Public Health Service, Washington, D.C., National Center for Air Pollution Control, Rept. ANL/ES-CC-001 and TID-4500, 106p., Feb. 1968. 7 refs. CFSTI

The Chicago Department of Air &ollution Control, the Department of Health, Education, and Welfare and the Argonne National Laboratory are engaged in a joint effort to develop a computer program which will predict the dispersion of sulfur dioxide produced by coal and oil-fired plants in the City of Chicago. A statistical model rather than a physical, deterministic model is attempted due to the availability of a large data inventory. By statistically 'force-fitting' air quality data into a matrix which includes standard meteorological parameters and SO2 emission data, a semi-empirical, computerized pollution forecasting technique might be developed which will circumvent many of the difficulties inherent in the attempt to simulate complex atmospheric diffusion processes. Functionally, the Argonne statistical modeling program may be divided into four major areas of effort. These are: (1) diffusion analysis, (2) meteorological studies, (3) emission inventory, (4) computer programming. Certain tasks and sources of information are associated with each of these functional areas. Ancillary to the development of a dispersion model is the initiation, during the first phase of the program, of preliminary studies in the area of the economics of air pollution abatement. These studies represent in a sense, an introduction to the second phase of the Argonne air pollution program, in which the development of abatement strategies and the evaluation of the economic implication of these strategies constitute the mainstream effort. A brief discussion of a proposed optimal abatement gaming strategy which could be evaluated during the current phase of the program and which would serve as a precursor of the more comprehensive studies to be conducted in the second phase is included.

11370

Voeikov, A. I.

TEMPORARY METHOD FOR THE COMPUTATION OF DISPERSION IN THE ATMOSPHERIC AIR OF SUCH DISCHARGES AS ASH, AND SULFUR CONTAINING GASES RELEASED THROUGH ELECTRIC STATION SMOKE STACKS. (APPENDIX 2.) In: Maximum Permissible Concentrations of Atmospheric Pollutants, V. A. Ryazanov and M. S. Gol'dberg (eds.), Translated from Russian by B. S. Levine, U. S. S. R. Literature on Air Pollution and Related Occupational Diseases, Vol. 15, pp. 121-129, 1968. CFSTI: PB 179140

Theoretical investigations and practical experimentation under practical and natural conditions in the proximities of electrical heat and energy stations were conducted. General formulas based on these studies could be computed which could apply to different climate conditions. The previously developed theory of turbulent diffusion had been re-examined by modern methods for solving differential equations with the aid of electronic computers, and the results were checked and rechecked to a point of satisfactory agreement between results of computed and actual determinations. The proposed method for the calculation of smoke stack discharge dispersion is based on theory and on the experimental investigations conducted. The method, should be regarded as a temporary expedient until further checking will establish its validity or superiority to pre-existing methods.

11514

M. Parry

SOURCES OF READING'S AIR POLLUTION. Preprint, Reading Univ., England, (17)p., (1968). 7 refs. (Presented at World Meteorological Organization's Symposium on Urban Climates and Building Climatology, Brussels, Oct. 18, 1968.)

An air pollution investigation was made of the town of Reading, England. Smoke and sulfur dioxide were measured at 37 stations. Most of Reading's measured pollution is of domestic origin. The influence of local emission sources of air pollution was discussed. The small central commercial district showed high sulfur dioxide values. The close correlation between high pollution values and high building densities emphasized the significance of local sources in determining pollution patterns and the importance of upward dispersion by turbulence as the main agent of removal. A numerical assessment of the contribution from distant sources to Reading's smoke during winter 1961-62, taking into account wind direction frequencies, gave a figure of over 40%. The mechanisms that bring external pollution to Reading are dependent on local sources. Favorable meteorological conditions for this situation were anticyclonic conditions, light easterly winds and low-level inversions. Another mechanism was that of large- scale fumigation over urban areas. Data on meteorological and pollution patterns are presented in forms of isopleths and maps.

11624

Berger, A. W., C. E. Billings, R. Dennis, D. Lull, and P. Warneck

STUDY OF REACTIONS OF SULFUR IN STACK PLUMES. (FIRST ANNUAL REPORT APRIL 12, 1967 TO APRIL 11, 1968.) GCA Corp., Bedford, Mass., Technology Div., Contract PH-86-67-125, GCA-TR-68-19-G, 129p., March 24, 1969. 30 refs.

The overall objective was to provide an improved rationale for predicting the concentration levels of sulfur oxides in the atmosphere. The study has been divided into two major phases; (a) a field program in which real plumes from coal and oil-fired power stations can be tracked by aircraft to determine plume composition as a function of downwind distance, environmental factors and source parameters; and (b) a laboratory program in which flue gas effluents generated by a pilot plant furnace (oil and coal fired) can be studied under simulated field conditions. Bench scale experiments to investigate several alternative mechanisms (chemical and/or physical) contributing to observed SO2 losses in the atmosphere are also included in the first-year program. Two Boston area power plants, one coal fired and the other oil fired, are allowing measurement of source parameters. The selected coastal stations are located such that no interference between their respective plumes takes place during periods of off-shore winds. Plume sampling was conducted under pre-selected meteorological conditions which would allow for maximum plume stability. Plume location beyond the visible range was determined by an automatic conductivity analyzer. A 42-cu ft reaction chamber was constructed to investigate atmospheric behavior of SO2 from stack plumes under controlled temperature, humidity, and simulated solar irradiation. Bench scale experiments were performed in which quantum yields were determined for pure SO2 and mixtures of SO2 for various uv excitation levels, 2537 and 3100A, at ambient pressure.

11980

Hasek, Milan

ON THE PROBLEM OF TRANSPORT AND DISPERSION OF GASEOUS HARMFUL SUBSTANCES FROM BIG THERMAL POWER PLANTS IN FLAT TERRAIN. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly Ash From the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 55-60.

Aspects of the mathematical solution of the transport and dispersion of gaseous pollutants from large-scale stationary sources are discussed, with emphasis on the special cases of fumigation, reflection, inversion, or condensation of smoke emissions from such sources. The Hewson formula, which is specific for reflection of smoke from bulk sources, is reviewed. The elaboration of relationships between the various emission, meteorological, and diffusion parameters is necessary to determine a methodology for meteorological data collection prior to construction of industrial plants in 'unknown' terrain. The determination of turbulent parameters for calculating pollutant concentrations is a difficult problem because of the lack of suitable equipment, in which case substitute data of more easily-measured variables are sometimes substituted. Appropriate theoretical treatment is outlined of wind velocity, variability of wind direction, and stack height factors.

12353

Slawson, P. R.

ON THE MEAN PATH OF BUOYANT BENT-OVER PLUMES UNDER VARIOUS ATMOSPHERIC STABILITY CONDITIONS. Waterloo Univ., Ontario, Dept. of0 Mechanical Engineering, AEC Rept. NYO-3685-14, RR-13, 92p., Aug. 1968. 19 refs. CFSTI: NYO-3685-14

Photographic observations were made on the rise of smoke plumes from a generating station in Ontario, in the spring of 1965 and 1967. Data relating to the stack variables were collected in detail. The mean path of a buoyant bent-over plume was described by a theory that considered the plume to rise in three distinct phases. The first phase was based on the entrainment hypothesis of Morton, Taylor, and Turner, 1956. The second and third phases modified this entrainment hypothesis considerably and were based on more established theory. The diffusion processes within the plume were attributed to self-generated turbulence and atmospheric turbulence of the inertial subrange eddies and the energy containing eddies for the second and third phases, respectively. Observations indicated that the dynamical problem of plume rise is very complex. This complexity was illustrated in the wavy appearance of plumes observed at the generating station in unstable atmospheric conditions. Further evidence was collected in 1967 which gave the linear rising plume for the final phase in neutral atmospheric conditions. The relatively simple theory presented correctly predicted (at least qualitatively) the complex observed plume paths and emphasized the important physical factors required to adequately describe this path. The plume's own physical size and the atmospheric turbulence level had a more direct effect on plume behavior than the observed atmospheric temperature gradients, at least for distances from the source of a few thousand feet. In some cases where the plume bends over sharply very near the source, the effect of the initial size and momentum of the plume may be important. (Author abstract modified)

13965

Parczewski, Wladyslaw

INFLUENCE OF THE STABILITY OF ATMOSPHERE ON THE CONCENTRATION OF AIR POLLUTANTS. (Einfluss der Stabilitaet der Atmosphaere auf die Konzentration der Luftverunreinigungen). Text in German. Z. Meteorol., 20(1-6):99-100, 1968.

Continuous measurements were made of the SO2 content of air near the ground by means of an EEL SO2 meter mounted on a vehicle in the vicinity of the 120 meter-high smoke stack of the Skawina (Poland) power plant at different types of stability of layering and at different wind speeds. The same type of measurements were also made at the distance of 1 kilometer from the Turoszow power plant. The results show sharp quasi periodic fluctuations of the SO2 content between 0.3 and 0.8 mg/cu m under labile layering conditions. At stable layering, its fluctuations are much smaller and its mean value decreases with increasing wind speed. The type of SO2-content fluctuations is well correlated with the type of layering of the atmosphere, so that knowledge of either one will enable inferences to be made regarding the other.

14271

Shirvaikar, V. V., Ramesh K. Kapoor, and L. N. Sharma

A FINITE PLUME MODEL BASED ON WIND PERSISTENCE FOR USE IN ENVIRONMENTAL DOSE EVALUATION. Atmos. Environ., vol. 3:135-144, 1969. 1 ref.

Dose measurements for evaluating the hazards of emissions from nuclear reactors are usually based on finite period releases of the effluent. The dose at any distance downwind is then calculated by multiplying the concentration from a continuous point source plume by the period of release. This method is unrealistic because it assumes a very large persistence of wind direction and diffusion conditions. The possibility exists that a change in the mean wind direction occurring at some point during the period of emission could lead to a spread of the material over a far wider area than is possible by turbulent fluctuations. Therefore, the worst meteorological condition defined for any reactor site should include information about wind direction persistence and associated lowest mean wind speed. In this paper, a plume model for release in finite wind persistence periods is developed. Equations are presented for computing dosage during the period of persistent wind direction and dosage due to the transit of the oblique plume in the changed wind direction at the end of the persistence period. The equations take into account the change in diffusion conditions before and after the wind direction change. Good agreement exists between approximate values and numerically integrated dosages computed on a CDC 3600 computer. (Author abstract modified)

15178

Peterson, Eugene K.

CARBON DIOXIDE AFFECTS GLOBAL ECOLOGY. Environ. Sci. Technol., 3(11):1162-1169, Nov. 1969. 10 refs.

Atmospheric concentrations of carbon dioxide are projected to the year 2000 and beyond, and the effect of anticipated influence on weather and global ecology are discussed. By 2000, if the burning of fossil fuel is not curtailed, atmospheric CO2 will increase 20-60% above 1950 levels to about 415 ppm. The CO2 will increase still another 30% by 2020 to 540 ppm. These amounts could increase average global temperatures by 1-5 F. Accompanying increases in plant growth may occur and result in a net reduction of atmospheric CO2. The increased growth rate of land and marine plants will more likely be balanced by an increased decay rate of plant material. Measurable melting of ice caps is anticipated by 2000, leading to a rise in ocean levels and major increases in earthquakes and volcanic activity. Techniques to reduce the CO2 content of the air or speed its absorption by oceans are theoretically possible but economically unfeasible. More practical methods of controlling CO2 emissions would substitute water power, geothermal steam, direct solar energy, and nuclear power for energy derived from fossil fuels. Research programs to determine the long-term effects of atmospheric CO2 are imperative. The U. S., as a major fuel oil consumer, should be a major participant in such research.

15347

Meyer, Erich

SULFUR DIOXIDE EMISSION AND SMOG FORMATION. (Schwefeldioxid-Emission und Smog-Bildung). Text in German. Chem. Ing. Tech., 41(19):1056-9, 1969. 13 refs.

In 1962, 35% of atmospheric SO2 in West Germany was emitted by thermal power plants, 46% by other industrial sources, and 19% by domestic heaters. In 1965, power plants emitted 29%, the remaining industrial and domestic sources 71%. The atmospheric SO2 concentration (mg SO2/cu m) depends on stack height, the amount emitted, distance from the source of emissions, and on meteorological factors. Among the latter, temperature-lapse rates have great importance. The formation of smog depends not only on SO2 levels and inversions, but also on the catalytic activity of finely divided solid particles, intense solar radiation, and high relative humidity. Measures for limiting SO2 emissions are outlined. These fall into three categories: decontamination of fuels or removal of the toxicants from waste gases, the use of low-sulfur fuels, and curtailment of industrial operations.

15483

Johnson, Warren B., Jr. and Edward E. Uthe

LIDAR STUDY OF STACK PLUMES. (FINAL REPORT). Stanford Research Inst., Menlo Park, Calif., Contract PH 22-68-33, Proj. 7289, 116p., June 1969. 11 refs.

The feasibility of lidar (laser radar) for stack plume studies was established from the results of an experimental investigation of plume behavior from a 245 m power plant stack in western Pennsylvania. Sixty-four vertical plume cross sections representative of various types of plume behavior were selected for detailed analysis. Each vertical cross section was built up from 15 to 30 lidar shots at 5 to 8 sec intervals and at elevation angle increments of one-third to 10 deg. Although calculated plume-rise values agree reasonably well with the observations, it is clear from inspection of the cross sections that the important effects of vertical wind direction shear (plume tilting and fanning) and vertical changes in stability (plume trapping) should be taken into account when predicting plume rise and diffusion. Close correspondence between plume tops and levels of increased atmospheric stability was found. Optimum use of lidar for diffusion studies requires provision for obtaining 30 min or hourly plume concentration distributions, as well as allowances for the effect of the lidar noise level upon plume size. The advantages of the mobile lidar technique stem from its ability to obtain measurements remotely and at a high density in space and time. The quantitative application of the technique for obtaining absolute particulate mass concentrations is limited mainly by the accuracy with which the optical characteristics of the aerosol are known. (Author abstract modified)

15511

Frizzola, John A.

THE ASCENT OF POWER PLANT FUMES DURING VARIOUS METEOROLOGICAL CONDITIONS. Preprint, Brookhaven National Lab., Upton, N. Y., 19p., 1969. 19 refs. Presented before the American Power Conference, Annual Meeting, 31st, Chicago, April 22-23, 1969, Paper BNL 13513.)

The theory of forced plume use from tall stacks, such as those used in the power industry, is reviewed, and factors affecting plume behavior are discussed. Two equations are suggested for obtaining a reasonable first approximation for plume rise during various weather conditions; they contain both important source and meteorological parameters. The equations are not valid during occurrences of light wind speeds since, at 1000 ft or above, plume rise depends on the presence of small discontinuities in the environmental lapse rate for unstable or neutral conditions. The meteorological conditions are assumed to prevail over durations of time equivalent to the averaging time selected for the passive diffusion parameters used in predicting ground level concentrations. Since the plume fluctuates from moment to moment, an hour is required to obtain an average plume height. It is emphasized that the equations are primarily intended for solving simple problems. As more observations of plume ascent and passive diffusion become available, particularly at heights above several hundred feet, further refinements will be necessary and desirable.

16285

MacDowall, Joseph, Andrew J. Moffat, and Herschel H. Slater

THE USE OF AN AIRBORNE SPECTROMETER FOR THE RAPID SURVEY OF ATMOSPHERIC SO2 AIR POLLUTION. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 23p., 1969. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 62nd, New York, June 22-26, 1969.)

An aerial survey of the area down-wind of a coal-fired generating plant in Tennessee was conducted using an airborne spectrometer. Pibal wind observations were obtained during the course of the survey. The meteorological conditions observed were those which would favor the transport of sulfur dioxide from the plant to the city. The airborne survey observed the plume on seven traverses at distances up to 20 miles down-wind of the plant. It was concluded that sulfur dioxide from the generating plant followed the mountain slopes which formed the eastern side of the Sequatchie-Tennessee River Valleys. Significant portions of the plume were neither observed to cross the Cumberland Plateau, which lies between the plant and Chattanooga, nor to enter the Tennessee River Gorge, which courses the Plateau. The experiment demonstrated the capability of the remote airborne detection device to track a sulfur dioxide plume for nearly 20 miles. It indicated the potential usefulness of the airborne system for making rapid, near-synoptic area surveys for air contaminants. Such surveys, if appropriate weather data are collected simultaneously, can provide data for rationally selecting air quality measuring sites. The device represents a potential for gathering information on the location of the emission sources, their source strength, and variations in the rates of emission. (Author abstract modified)

16467

Voloshin, V. G.

THE DISTRIBUTION OF SURFACE CONCENTRATIONS OF HARMFUL ADMIXTURES IN REGION OF POWER STATION IN ODESSA. (Raspredeleniye prizemnykh kontsentratsiy vrednykh primesiy v zone Odesskoy TETs). Text in Russian. Meteorol., Klimatol. i Gidrol., no.3:38-45, 1968. 6 refs.

Measurements of aerosols and SO2 are taken as a basis in this study of air pollution resulting from the combustion of coal at the Odessa Heat and Power Plant. Maximum pollution from the plant (at a distance of 2400 m from the stack) reached 0.27 mg/sq m for SO2 and 0.20 mg/cu m for aerosols, or 40-50% of the total concentration in the surrounding areas. Pollution concentration under the plume reaches as high as 0.6-0.7 mg/cu m, a north-south orientation predominating due to prevailing winds. Under anomalous conditions of atmospheric stratification the maximum permissible concentration (0.5 mg/cu m for both SO2 and aerosols) may be exceeded 2-3 fold. The area within a 3-4 km radius of the Odessa industrial region is deemed unsuited for the construction of new multiple-dwelling structures because of high pollution levels.

16629

Szepesi, Dezso

METEOROLOGICAL CONDITIONS OF THE TURBULENT DIFFUSION OF ATMOSPHERIC POLLUTANTS IN HUNGARY. (Legszennyezo anyagok turbulens diffuziojanak meteorologiai foltetelei magyarorszagon). Az Orszagos Meteorologiai Intezet Hivatalos Kiadvanyai (Budapest) (Natl. Meteorol. Inst. Offic. Publ.), vol. 32, 168p., 1967. 83 refs. Translated from Hungarian. Franklin Inst. Research Labs. Philadelphia, Pa., Science Info. Services, 207p., Sept. 1969.

A mathematical model is developed to incorporate the meteorological factors influencing the dilution of atmospheric pollutants from a point source, with a view towards optimizing the location of such installations as electric power plants. The model takes into account wind direction, wind speed, vertical wind profile, and thermal stratification by use of the equation of turbulent diffusion, with results calculated in average number of hours per year during which a concentration of pollution exceeds a given level. The computations are made by computer, and solutions based on new industrial and meteorological data can therefore be obtained rapidly. The method is applicable to sites at which ground level and upper-air wind observations have been made for at least a year or which are located no more than 150 km from an existing meteorological observatory in a broad lowland-type area. The turbulent diffusion equations are also programmed for determining the necessary stack height and emission velocity of the combustion gases of a power plant to achieve permissable emission levels in the region surrounding the power plant. The principal subject headings dealt with are meteorological, topographic, and industrial factors in air pollution; quantitative analysis of meteorological data; early investigations of turbulence and diffusion by Turner; and theory and application of the turbulent diffusion method. Two-hour values of the stability parameter for Budapest and 12 other cities for 1959-1963 have been calculated and are presented in a form ready for computerization; the values were interpolated from four daily radio sonde ascents on the basis of observed values of cloud cover, temperature, and the hourly wind values with reference to the isopletes of the average temperature gradients of the lower 300 m of the atmosphere.

16687

Onikul, R. I., G. A. Panfilov, B. V. Rikhter, and R. S. Gil'denskiol'd

RESULTS OF ANALYSIS OF EXPERIMENTAL DATA CHARACTERIZING THE DISTRIBUTION OF ATMOSPHERIC POLLUTIONS NEAR THE THERMAL ELECTRIC POWER STATIONS. (Rezul'taty analiza eksperimental'nykh dannykh, kharakterizuyushchikh raspredeleniye atmosfernykh zagryazneniy vblizi teplovykh elektrostantsiy). Tr. Gl. Geofiz. Observ. (Moscow), no. 172:23-34, 1965. 13 refs. Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio, Translation Div. FTD-MT-24-186-67

Meteorological and aerological data were collected on the diffusion of sulfurous gas and ashes from stacks of thermal electric power stations from 1961 to 1963. A method for analyzing the experimental data on surface concentrations at various distances from the plants was described in detail and contrasted with conventional methods of finding average sulfur dioxide concentrations. The method permits the determination of maximum SO2 concentrations and calculations of dangerous wind speeds. The results obtained by the method were in good agreement with theoretical calculations. Maximum SO2 concentrations at all sampling points were related to the wind speed, which depended on the initial flue gas exit speed from stacks and the degree of their overheating. At low speeds, flue gases rise to a great height. At higher speeds, the effective height is small, but the gases are dispersed over a greater distance. Rapid increases in surface concentrations follow initial increases in wind speed, but only very small changes in surface concentrations occur thereafter.

16803

Jarman, R. T. and C. M. deTurville

THE VISIBILITY AND LENGTH OF CHIMNEY PLUMES. Atmos. Environ., 3(3):257-280, May 1969. 26 refs.

Nonhebel's (1960) theoretical analysis of chimney smoke visibility is extended to incorporate the scattering of sunlight and skylight by plume particles. Relations are derived theoretically which show how both the visible length and the smoke contrast depend on the particles in the plume and the weather conditions. The theory treats inert particles which do not change by chemical reactions in the atmosphere or coagulation, etc. It is also limited to low particle concentrations where multiple scattering effects may be ignored. The accuracy of the calculation of the visibility and length of plumes from commercial power stations is limited because the optical properties of the smoke particles are not known accurately. However, using approximations for the optical properties of the complex smoke particles, given by the Mie theory for uniform spheres, it was found that there was reasonable agreement between the observed and calculated plume lengths and contrasts. It is known that in stable atmospheric conditions some plumes occasionally remain visible for some miles downwind of the chimney. These persistent plumes are discussed briefly and simple criteria for their occurrence are derived. (Author's Abstract)

16985

Scorer, R. S.

WET AND COLOURED PLUMES AND NATURAL POLLUTION. In: Air Pollution. London, Pergamon Press, 1968, Chapt. 5, p. 86-106.

The thermal, mechanical, and optical effects that influence visible air pollution are explained. The behavior of wet-scrubbed effluent gas from power station is variable because it depends on the amount of water evaporated in the washing chamber and the extent of the subsequent cooling before emission; these, in turn, depend on the temperature ranges of the water and gases in the washing, and are determined by their flow rates and mechanisms of contact. Distinction is made between droplets from splashing in a cooling tower or scrubbing chamber and droplets formed by condensation due to cooling like smoke and pollution gases, the latter travel with the air. Condensation of water cloud after emission is a good feature of a plume from the standpoint of pollution on the ground; condensation before emission by cooling in a stack or washing chamber is very undesirable. The basis for these principles is explained and numerous photographs provide illustrations of varieties of plume appearance and behavior. The whiteness of a sulfur trioxide-laden plume is determined as much by the size of the particles as by the amount of SO3 present; SO3 plumes are blue when the particles are very small, become white at some larger size, and then become invisible when the same amount of SO3 is condensed into still fewer large particles. Colored plumes may take their color from the particles of smoke that make them visible; micron-size particles of red iron oxides create the red smoke often seen at steelworks. Sulfuric acid mist may produce a blue color when the particles are very small, and the reddish brownish color of some power station plumes is the natural color of the small fly ash particles which pass through the electrostatic precipitators. Some forms of visible natural air pollution are discussed, including salt haze from the sea, dust hazes, and blizzards.

17580

Thomas, F. W., S. B. Carpenter, and W. C. Colbaugh

RECENT RESULTS OF MEASUREMENTS. PLUME RISE ESTIMATES FOR ELECTRIC GENERATING STATIONS. IV. Phil. Trans. Roy. Soc. London Ser. A, vol. 265:221-243, 1969. 11 refs.

Starting in 1963, the Tennessee Valley Authority collected and analyzed data for documentation and definition of plume rise and related meteorological parameters at generating plants with unit ratings from 173 to 704 MW and stack heights from 76.2 to 182.9 m. Plume rise data plotted against calculated values of all formulas used in this report indicated that the wind speed and heat emission rate are the principal determinants in calculating plume rise. The effect of the stack height on plume rise is inherent in the stability factor for this analysis. When plume observations were plotted against calculated values according to the formulas originally presented, the simple Concawe formula provided the best fit. The equations used can be summarized as plume rise equals A/u(a), where A is some function of the kinetic and thermal energy of the plume and u is the wind speed. The Concawe formula is considered preferable for general investigation because of simplicity and ease of calculation. But when a particular event, such as inversion breakup or limited mixing layer fumigation, is being analyzed, use of the 'two-thirds power law' is considered preferable, provided information for the meteorological parameters is available. This relation embodies the principal physical quantities normally associated with plume rise and permits some accounting for up to 15% difference in plume rise attributable to variation in atmospheric stability. The study served to validate plume rise formulas which can be effectively over a range of meteorological and operational conditions. (Author conclusions modified)

17595

Ide, Yasuo

SIMILITUDE ON STACK GAS DIFFUSION. Preprint, Mitsubishi Heavy Industries, Ltd., Tokyo (Japan), 11p., 1966 (?). 6 refs.

Stack gas diffusion in the atmosphere is governed by the mean flow of the natural wind and its turbulence. Atmosphere is divided into: free atmosphere (above 500-1000 m); planetary boundary layer (below 500 m); and surface boundary layer (less than 100 m in altitude). Stack gas emitted from power stations (200-1000 MW) usually rises into free atmosphere and diffuses with the planetary boundary layer. Stack gas is damaging when the concentration of diffusing gas (plume) is greater than the permissible level. The spectrum of horizontal wind speed is illustrated. Wind may be classified as: (1) macro scale turbulence (a synoptic-scale motion associated with macrometeorology); (2) meso scale turbulence (short term variation of wind speed of direction); and (3) micro scale turbulence (eddy motion or fluctuation of wind speed or direction). The three scales are illustrated. The direct method and the indirect method can be used to estimate or predict atmospheric diffusion. The indirect method is generally adopted by air pollution engineers for it takes into account the effects of down wash, down draught, topographical effect, etc. The indirect method is adopted in the discussion on similitude and is confined to stack gas diffusion in the micro scale. A chart of similarity parameters for diffusion is given.

17612

Berlyand, M. Ye. and R. I. Onikul

PHYSICAL BASES FOR CALCULATING THE SCATTERING OF INDUSTRIAL EMISSIONS IN THE ATMOSPHERE. (Fizicheskiye osnovy rascheta rasseivaniya v atmosfere promyshlennykh vybrosov). Text in Russian. Tr. Gl. Geofiz. Observ. (Leningrad), no. 234:3-27, 1968. 53 refs.

Theoretical work related to atmospheric dispersion of impurities from industrial sources is reviewed. Practical recommendations are set forth with regard to the design of industrial enterprises so as to comply with standards for maximum allowable concentrations and establish so-called sanitary protection zones. Verification of these methods at several regional electric power stations at Minsk, Tallin, Bobruysk, Alma-Atinsk, Karagandinsk, and Daugavpilask and the Chelyabinsk Metallurgical Plant is reported.

17725

Honma, Tadao

METEOROLOGICAL CONDITIONS AND SMOKE DIFFUSION. 50. ANALYTICAL METHOD FOR THE DEGREE OF WIDESPREAD AIR POLLUTION AND COUNTERMEASURES AGAINST SUCH POLLUTION. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):70-77, 1967. Translated from Japanese. 4p.

Countermeasures against sulfur dioxide pollution using the standard of (polluted area) times (average concentration) are discussed. A new analytical method was proposed, and countermeasures were studied, based on the examples of calculation. Several equations are presented which give the degrees of linear and areal pollution from a given smoke source. Assuming that these degrees are the reasonable quantities of the pollution affecting the district concerned, practical nomographs were prepared. The degrees of linear and areal pollution were calculated after the amount of fuel consumption in industrial cities had been divided into large scale, medium scale, and small scale groups. The height of the chimneys, the sulfur content, and the number of smoke sources were also properly chosen. The degrees of pollution affecting the whole district, or the midtown area and the residential area, for each scale were given. Sulfur dioxide can be reduced by using low sulfur oil in small scale factories, and high sulfur oils in large scale factories. Increasing the height of the chimneys of medium scale factories is also of importance in lowering pollution. The extent of the effect of power plants on the ground surface SO2 concentration 20 km from the midtown area was less than 10%.

17734

Horiuchi Kazuya, Tooru Fujii, and Hachiro Yasukawa

METEOROLOGICAL CONDITIONS AND SMOKE DIFFUSION. 59. A STUDY OF THE ENVIRONMENTAL POLLUTION CAUSED BY A HUGE GENERATING SOURCE. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution) 2(1):70-77, 1967. Translated from Japanese. 2p.

The diffusion state of sulfur dioxide emitted by the chimneys of a steam power plant was investigated. The SO2 concentration measuring points were set up to the north and the southeast of the plant, taken as the origin; each point was positioned on concentric circles of 2, 6, 8, 10, and 12 km. Continuous measurement was conducted at one hour intervals. The wind direction and speed on the ground were observed by a Koshin-vane. To obtain meteorological data in the upper air, the temperature and wind speed were observed up to 500 m above the ground by means of a captive balloon. Photographs were taken from airplanes to determine the height of the rising smoke. The results of the 1954, 1965, and 1966 investigations showed that the SO2 concentration tends to increase each year with an increase in the consumption of heavy oil.

19503

Homma, M. and M. Suzuki

HEIGHT OF PLUME FROM STACK OF LARGE THERMAL POWER STATION. (Daiyolyo kalyokoo natsoodenjo entotsoo kala no haien johshoh takasa). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):95, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

The comparison among formulas for height of plume rise, which have been published but give considerable differences, was based on measured values of plumes from thermal power plants. A modified Bosanquet II equation was recommended earlier which uses 0.26 U(1/2) as a plume expansion coefficient instead of 0.13 suggested by Bosanguet. Within the wind velocity of 1 10 m/sec, this modified Bosanquet-II equation agrees with the measured values and Lucas's, Moore and Spurr's and Thomas's equations show comparatively good agreements above 4 m/sec. Priestly's and Holland's equations give fairly lower values. These measurements are taken where the heat emission rates of plume sources lie between 45 and 17 times 10 to the 6th power cal/sec (150 and 600 MW), in daytime, and under approximately neutral condition of the atmosphere. It is necessary to consider in more detail the height-of-rise in the case of the very weak wind. The measurement of the height of rise are done by both photos (which are analyzed graphically,) and the measurement of the vertical distribution of sulfur dioxide concentration in a plume by a helicopter.

19737

Roberts, J. J., E. J. Croke, and A. S. Kennedy

CHICAGO AIR POLLUTION SYSTEMS ANALYSIS PROGRAM. AN URBAN ATMOSPHERIC DISPERSION MODEL. Argonne National Lab., Ill., Dept. of Air Pollution Control, Chicago, Ill., and Public Health Service, Washington, D. C., National Air Pollution Control Administration, 116p., Oct. 1969. 23 refs. (Presented at the Symposium on Multiple Source Urban Diffusion Models, University of North Carolina, Chapel Hill, Oct. 27-30, 1969.) CFSTI: ANL/ES-CC-005

A multiple source, computerized atmospheric dispersion model designed for operational use in air resource management was formulated and programmed for the IBM 360-75 system. The model consists of a series of algorithms assembled around a kernel which represents the transport and diffusion of pollutant species from point and area sources according to a Gaussian distribution in three dimensions. This kernel, which represents a three dimensional puff of smoke, is integrated according to a time series of piecewise constant wind vectors and piecewise constant atmospheric stability parameters to simulate the transient behavior of a continuous smoke plume. The model is incorporated in a master air pollution data management system which is employed to store, retrieve, process, analyze, and display emission, meteorology, and air quality data. The development and preliminary validation testing of this model is described against data from a three-year, computerized inventory of sulfur dioxide air quality data recorded by the receptors of the Chicago telemetered air monitoring system. A detailed, two-year inventory of Chicago coal and oil burning SO2 emission sources was acquired, data storage formats were designed, and computer algorithms were developed to generate hourly average estimates of emissions from major utility, industrial, residential, commercial, and institutional sources. The ratio of standard deviation to mean values for all hourly SO2 predictions is 0.93 for approximately 2300 data points. (Author summary modified)

20042

Berlyand, M. Ye., Ye. G. Genikhovich, and O. I. Kirenbin.

EFFECT OF RELIEF ON PROPAGATION OF POLLUTANTS FROM SOURCES. (Vliyaniye rel 'efa na rasprostraneniye primesi ot istochnikov). Text in Russian. Tr. Glav. Geofiz. Ovserv. (Leningrad), no. 234:28-44, 1968. 17 refs.

A further development of earlier work on evaluating the effect of local surface irregularities in calculations of a pollutant concentration field is presented. A more rigorous model is employed together with analysis of pollutant propagation in a potential (rather than real) flow. Field work carried out at the Shchekino Regional Power Station is used as the basis for a sample analysis.

20068

Nakamura, A. and T. Masuda

OBSERVATIONS ON ASCENT OF SMOG LAYER AND ITS EFFECTS ON CONCENTRATIONS. (Emmuso josho no kansokurei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):99, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

In a flat metropolitan area such as Sapporo, Japan, where the source of air pollution in winter is mainly the smoke stacks for household and industrial heating, the dissolution of the inversion layer results in the rising of the stable layer; trapped by the unstable layer underneath, pollution increases in concentration with the emission increase. Furthermore, the pollutants reach the higher altitudes with the dissolution of the stable layer (expansion of the unstable layer). Several photographic observations and sulfur dioxide samplings were conducted during the winter of 1968-69.

20163

Yeliseyev, V. S.

DETERMINATION OF ATMOSPHERIC DIFFUSION PARAMETERS FROM VISIBLE CHARACTERISTICS OF A SMOKE CLOUD. (Opredeleniye parametrov atmosfernoy diffuzii po vidimym ochertaniyam dymovogo oblaka). Text in Russian. Tr. Gl. Geofiz. Observ. (Leningrad), no. 185:77-82, 1966. 7 refs.

Helicopter observation of smoke plumes at distances up to 15 km and more from the source has proven to be a sensitive indicator, both qualitatively and quantitatively, of atmospheric diffusion. Observation flight patterns and theoretical interpretation of observations are reviewed. Though these conclusions are based on observations made in 1962-1963 in the Shchekinsk Region and at the State Regional Power Station in Cherepetsk, no data are given.

20523

Tsang, Gee

CONCENTRATION OF EFFLUENTS IN A PLUME AS PREDICTED BY A MODEL AND OBSERVED IN FIELD. Massachusetts Inst. of Tech., Cambridge, Fluid Mechanics Lab., Grant AP 00678-01, Pub. 69-7, 9p., Aug. 1969. 6 refs.

A theoretical model based on the entrainment concept and the assumption of a 'top-hat' distribution profile was used for predicting the concentration of SO2 and SF6 in a plume. The theoretical predictions were compared with field data collected by Berger et al and Dennis et al in a plume from a power station situated by the seashore. The sampling was made by an airplane criss-crossing the plume at various downwind distances and at various altitudes. To avoid the effect of ground roughness, sampling was only made when the plume was blown off-shore to the sea. The stretch of the plume being sampled was from 1/4 miles to 20 miles. The plume boundary was determined by an airborne electro-conductivity analyzer which could respond to an increment in SO2 levels above the background level within 5 seconds. The comparison shows that the theoretical model does correctly predict the concentration of pollutants in a plume. Comparison of the SO2 and SF6 concentrations (the latter was an inert gas released as a tracer) showed that in the experimental range of 20 miles, the depletion of SO2 is not an important factor in estimating the rate of dilution.

20924

Selickaja, V. I.

AN ANALYSIS OF THE AEROLOGICAL CONDITIONS FOR ATMOSPHERIC POLLUTION IN SOME REGIONS OF THE EUROPEAN U. S. S. R. Tr. Gl. Geofiz. Observ. (Leningrad), vol. 207:188-201, 1968. 5 refs. Translated from Russian by C. Long, Meteorological Office, London, England, 11p.

Meteorological observations being carried out in the lowest 500 m of the atmosphere for studies of interaction with air pollution are reported for three power station sites in the Moldavin, Cerepet, and Scekino regions of the European U. S. S. R. The data include mean values of air temperature, lapse rate, relative and specific humidity, and wind speed. Summary analyses of the data are presented, as well as notes on cloud cover. Measurements were made by balloon sounding. Considerable diurnal variation of all meteorological parameters was noted; it is therefore recommended that the number of night ascents be increased to allow more detailed study of the thickness and intensity of inversion layers which create hazards for surface layer pollution.

21073

Peterson, Kendall R.

CONTINUOUS POINT SOURCE PLUME BEHAVIOR OUT TO 160 MILES. J. Appl. Meteorol., vol. 7:217-226, April 1968. 8 refs.

In order to study the behavior of the plume emitted from the air-cooled nuclear at Brookhaven National Laboratory on central Long Island, N. Y., radioactive argon-41 was measured by an airborne gamma-ray spectrometer as far as 160 naut mi downward on a day with neutral stability. A vertical cross-section at 144 naut mi obtained by a vertical 'saw-tooth' sampling technique, showed the plume to be well organized with a nearly uniform vertical distribution to at least 2000 ft. The peak concentration, when corrected for radioactive decay, decease by about a factor of 7-10 over a distance of 150 naut mi and a travel time of 10-12 hr. The lateral standard deviation of the plume appeared to fit an extension of the Pasquill-Gifford 'D' curve with distance, where the plume, in naut mi is approximately equal to two-thirds of the travel time in hours. The usefulness of a vertical saw-tooth flight path was verified and is believed to be superior to a series of horizontal passes perpendicular to the plume. (Author abstract modified)

21099

Arin, M. L., C. E. Billings, R. Dennis, J. Driscoll, D. Lull, F. A. Record, P. Warneck, and J. E. Wilder

STUDY OF REACTIONS OF SULFUR IN STACK PLUMES. (SECOND ANNUAL REPORT). GCA Corp., Bedford, Mass., Technology Div., NAPCA CONTRACT PH-86-67-125, GCA-TR-69i12-G, 85p., Dec. 1, 1969. 10 refs. CFSTI: PB 185842

The results of the second year of a three-year study of the reactions of sulfur in stack plumes are presented; the basic program objective was to provide an improved capability for predicting sulfur oxide concentrations in urban atmospheres. The field program of airborne sampling of plumes from coal and oil-fired power stations in the Boston area was extended, with concurrent measurements of flue gas composition, plant parameters, and environmental factors. SO2 and SF6 tracers were tracked up to 20 miles downwind; beyond visible range, plume locations were determined by an automatic conductivity analyzer. Sampling procedures and other program conditions were developed in part on the basis on model analysis. The normal SO2 concentration decrease from meteorological dilution was distinguished from SO2 loss caused by chemical and/or physical mechanisms. Results of statistical analysis of field and stack data are given although technical and statistical difficulties prevented firm conclusions. Coal-burning tests made in a pilot plant combustion system showed that real field effluents could be generated in a laboratory over extended periods for simulated decay studies. Preliminary decay measurements of SO2-air mixtures were performed in a reaction chamber, and appeared to support the hypothesis that major atmospheric SO2 loss is associated with condensation phenomena. Experiments on reaction kinetics were also performed in a hemispherical reaction vessel in which quantum yields for SO2-02 mixtures over the range 10-100% SO2 could be determined. Methods, equipment, and interim results are given for all phases of the overall study, and descriptions of the combustion gas pilot plant and of the diffusion models used in the design and evaluation of the field program are included in the appendices.

21122

Reidat, Rudolf

FINDINGS ON THE VARIATION OF UNSTABLE WEATHER CONDITIONS IN THE LOWER PORTION OF THE ATMOSPHERE FROM TEMPERATURE RECORDINGS UP TO A HEIGHT OF 200 METERS AND THEIR APPLICATION IN SUPERVISING THE HAMBURG INDUSTRY. (Erkenntnisse ueber den gang der Instabilitaet der unteren Atmosphaere aus temperatureregisterierungen bisweihundert Mete Hoehe and inhre Anwendung bei der Beratung der Hamberg Indstrie. Inst. Gewerbliche Wasserwirtschaft Luftrein Halting Forum, vol. 6:41-58, 1967. 2 refs. Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 20p., Sept. 22, 1969.

The frequency and duration of stable air masses up to 500 m was determined from data obtained during weather observation flights between 1933 and 1944 before the construction of a large power plant near Stade. To determine how stack height would affect mixing in the immediate vicinity of the plant, temperature lapse rates were monitored up to 200 m. On a yearly average, 167 days with surface inversions were counted, one fourth of which reached a height of 200 m and one fourth, a height of more than 350 m. Seven eighths of these temperature inversions disappeared by afternoon. The days on which no mixing occurred averaged about 44 a year. Only one fourth of the stable weather conditions lasted longer than four days. The longest stable conditions prevailed in December. Analysis of the temperature lapse rates showed that half of the hours between midnight and sunrise are marked by temperature inversions which extend to 175 m. No inversions were recorded between noon and 2 P.M. It is concluded that high stacks reaching higher than surface haze emit smoke in a coning plume until midnight, after which stabilizing upper layers change the smoke plume to a fanning one. A special weather service is suggested to guard against emissions during stable conditions.

21736

Jarman, R. T. and C. M. de Turville

THE VISIBILITY AND LENGTH OF CHIMNEY PLUMES. Atmos. Environ., vol. 3:257-280, 1969. 27 refs.

Nonhebel's (1960) theoretical analysis of chimney smoke visibility is extended to incorporate the scattering of sunlight and skylight by plume particles. Relationships are derived theoretically which show how both the visible length and the smoke contrast depend on the particles in the plume and the weather conditions. The theory treats inert particles which do not change by chemical reactions in the atmosphere or coagulation, etc. It is also limited to low particle concentrations where multiple scattering effects may be ignored. The accuracy of the calculation of the visibility and length of plumes from commercial power stations is limited because the optical properties of the smoke particles are not known accurately. Using approximations for the optical properties of the complex smoke particles, given by the Mie theory for uniform spheres, there was reasonable agreement between the observed and calculated plume lengths and contrasts. It is known that in stable atmospheric conditions, some plumes occasionally remain visible for some miles downwind of the chimney. These persistent plumes are discussed briefly and simple criteria for their occurrence are derived. (Author abstract)

21986

Meetham, A. R.

NATURAL REMOVAL OF POLLUTION FROM THE ATMOSPHERE. Quart. J. Roy. Meteorol. Soc. (London), 76(330):359-371, Oct. 1950. 8 refs.

Observations of atmospheric pollution throughout Britain are considered in relation to the amounts of pollution emitted through the combustion of coal. The estimated weight of ash emitted into the air and the estimate, from deposit gauges, of the ash deposited, are considered likely to agree fairly well at a figure of over one million tons/year. On the assumption that about 1.5 million tons of smoke are blown to sea each year, about 1.1 million tons of sulfur dioxide are blown to sea each year; the remaining 0.8 million tons of smoke and 3.9 million tons of sulfur dioxide must be deposited in Britain, irrespective of the quantities measured in deposit gauges. The average life of a smoke particle before deposition on land is probably of the order of 1-2 days; that of a molecule of sulfur dioxide is estimated with rather more certainty to be less than 12 hours. Of the chlorides collected in deposit gauges more than half, as a rule, come from the sea, and less than half from the utilization of coal; but the ratio must vary with the position of the deposit gauge relative to the sea and to industries. (Author abstract)

22313

Fortak, Heinz

COMPARISON OF CALCULATED AND MEASURED MAXIMUM GROUND-LEVEL SO2 CONCENTRATIONS AND THEIR DISTANCE DOWNWIND FROM STRONG EMISSION SOURCES (POWER PLANTS). Staub (English translation from German o Staub, Reinhaltung Luft), 29(12):14-20, Dec. 1969. 7 refs. CFSTI: TT 69-55002/12

A simplified version of the theory of atmospheric diffusion is applied to simulate maximum ground-level sulfur dioxide concentrations measured near large power plants. The results depend strongly on the special form of the plume rise formula. Neither Csanady's original formula nor the new optimized version of it give satisfactory results. A slight modification of the exponent in the optimized Csanady-formula however seems to simulate the measurements in the best way. (Author abstract)

23163

Shidara, Masao

LECTURE ON PUBLIC NUISANCE. PART III. SO2 GAS POLLUTION CONTROL. 1. (Kogai boshi koza. 3. Dainiko Aryusangasu taisaku. jo). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(8):37-46, Aug. 1, 1970.

The maximum allowable concentrations and the percentile expression of environmental emission standards of sulfur dioxides are explaine and compared with emission standards in the United States and other European countries. Mathematical formulae are given for calculatin the effective height of smokestacks (Bosanquet's formula) and the ground surface concentration of pollutants at distances x, y from a stack (Sutton's formula). Various emission standards calculated by using the above formulae are given for the eight classes of designated pollution areas, the first class having the most stringent maximum allowable concentration (0.020 ppm). Such areas consist of parts of Tokyo, Kanagawa, Osaka, Mie, and Hyogo. One method of mitigating the air pollution from stacks is the construction of stacks with heights in the order of 200 m to disperse the pollutants in the upper atmosphere. A table of power generating stations with the corresponding stack heights is presented. Stack height must be determined in relation to down-draughts, down-wash, inversion layers, and the maximum allowable concentration. Different types of stacks are introduced and their merits and demerits are explained.

23409

Stephens, Nolan Thomas

FATE OF SULFUR DIOXIDE IN A PLUME. Florida Univ., Gainesville, Coll. of Engineering, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1969, 222p. 72 refs.

Current models for predicting sulfur dioxide concentrations after emission from industrial sources are limited by a lack of information on its decay rate or half-life. In this study, an instrumented aircraft was utilized in tracking sulfur dioxide and particulate matter after emission from power plants and smelters. Sulfur dioxide decay rates were ascertained by comparison of simultaneous sulfur dioxide and particulate matter concentrations. The particulate matter, 0.3 to 1.0 micron 'combustion spherules', emitted from the source served as a conservative tracer. Both SO2 and particulate concentrations were measured by a rapid response technique (less than two seconds delay), which permitted evaluation of the ratio of concentrations at any given point. An increase in the particulate to SO2 ratio was indicative of a loss of SO2, since the particulate matter was essentially a conservative element. The measurement techniques were effective up to 80 km. The results show that available moisture is a major factor in the decay of sulfur dioxide in smelter and power plant plumes. The half-life of SO2 was on the order of one hour at 75-80% relative humidity and on the order of two hours at 40-50% relative humidity. There was no detectable decay at 30-40% relative humidity. A first order reaction mechanism, combined with experimentally determined plume spread coefficients, provides a reasonable approximation of the decay and diffusive effects in plumes. (Author abstract modified)

23723

Bell, G. G.

METEOROLOGICAL EFFECTS ON CALIFORNIA AIR POLLUTION. Biometeorol. Proc. 3rd Int. Biometeorol. Congr., 1963, 2(2):628-640. 13 refs. (Sept. 1-7.)

Urban pollution experience in California arises from synergistic interaction of contaminants from a petroleum economy and certain features of a maritime coastal climate. The meteorologic effects of persistent inversions and a fugitive sea breeze coupled with pollution from extensive usage of motor vehicles produce episodic physiological strain on the urban population. Temporal changes in the avaiable atmospheric mixing volume in concert with strong topographic influences and contrasting temperature effects on natural ventilation produce a variety of influences on primary and secondary pollution. Diurnal variation in carbon monoxide concentrations is related to changes in both motor vehicle traffic and atmospheric stability, while a seasonal variation is a function of the consumption of natural gas and fuel oil for heating and power production. Seasonal meteorological variations combine durin the summer to maximize the photochemical creation of oxidants, while increased atmospheric stability during cold, rainless winters results in the occurrence of highest maximum concentrations of CO during pollution episodes. Reactions, physical properties, and emissions of atmospheric contaminants undergo substantial changes depending on the state of the atmospheric environment. Humidity, solar energy horizontal ventilation, inversion height, and cloud cover play important parts in these respects. Statistical studies of historical data on pollutant concentrations and meterological variates show a general upward trend for carbon monoxide and oxidants for 1955-1963. (Author abstract modified)

24109

Benson, Carl S.

ICE FOG. LOW TEMPERATURE AIR POLLUTION. Army Cold Regions Researc and Engineering Lab., Hanover, N. H., Grants DA-ENG-11-190-61-G3, DA-ENG-27-021-62-G5, and DA-AMC-27-021-64-G8, RR 121, 118p., June 1970. 196 refs. NTIS, DDC: AD 708544

Stable pressure systems over interior Alaska sometimes produce prolonged, extreme (below -40 C) cold spells at the surface. The rate of radiative cooling of the air is enhanced by suspended ice crystals which are themselves a result of the initial cooling. Radiation fogs formed during the onset of cold spells are generally of short duration. The polluted air over Fairbanks allows droplets to begin freezing at the relatively high temperature of -35 C. Between -35 and -40 C the amount of water vapor condensed by freezing of super-cooled water droplets is 3 to 5 times greater than the amount condensed by 1 C of cooling at these temperatures. This results in rapid and widespread formation of ice fog which persists in the Fairbanks area as long as the cold spell lasts. The persistence of Fairbanks ice fog depends on a continual source of moisture from human activities within the fog. Most of the ice fog crystals have settling rates which are slower than the upward velocity of air over the city center. The upward air movement is caused by convection cells driven by the 6 C 'heat island' over Fairbanks. This causes a reduced precipitation rate which permits the density of ice fog in the city center to be three times greater than that in the outlying areas. The inversions which occur during cold spells over Fairbanks begin at ground level and are among the strongest and most persistent in the world. Thus, the low-lying air over Fairbanks stagnates and becomes effectively decoupled from the atmosphere above, permitting high concentrations of all pollutants. The combustion of fuel oil, gasoline, and coal provides daily inputs of carbon dioxide, sulfur dioxide, lead, bromine, and chlorine into a lens-like layer of air resting on the surface. The air pollution over Fairbanks during cold spells is further worsened, because the mechanisms for cleaning the air are virtually eliminated while all activities which pollute the air are increased. (Author abstract modified)

24243

Macey, H. H.

MULTIPLE CHIMNEYS. Atmos. Environ., 4(3):327-332, May 1970. 8 refs. (Includes discussions by E. C. Halliday, D. H. Lucas, and Bjorn Bringfelt.)

A recent paper compared observed values of plume rise from a power station with four stacks, each 76.3 m high and 4.1 m inner diameter, with calculations based on the Bosanquet formula and that of Lucas, Moore, and Spurr. Both formulas were concluded to give values that are too small. The present author notes that the conclusion depends entirely on whether the calculation is made on one stack, ignoring the other three, or on the four stacks behaving conjointly with a merged total emission. The argument is advanced that four chimneys constitute a single emission and should be treated as such. It is further observed that essentially effective chimney heights can be calculated with the Bosanquet formula. Points made in the discussions appended to the paper are that the concept of four plumes combining to form one plum is acceptable only when stacks are within a few meters of each other, that plume rise cannot be used precisely to estimate stack height, and that plume rise formulas must consider the possibility that plume rise can be affected by high intensity turbulence near the ground. Also presented are the results of Swedish multiple source tests.

24341

Spurr, G.

THE PENETRATION OF ATMOSPHERIC INVERSIONS BY HOT PLUMES. J. Meteorol., vol. 16:30-37, Feb. 1959. 5 refs.

Power station chimneys emit hot gases which may be sufficiently buoyant to penetrate inversions associated with periods of smog. Two notable instances of smog in Great Britain were examined, applying formulae derived by Sutton and Priestley. A method has been suggested whereby an estimation may be made of the amount of heat required to ensure the penetration of an inversion by a plume. With calm or very light winds, it has been shown that a power station plume from a chimney serving 100 mw of plant or more will penetrate the worst inversion on record. (Author abstract modified)

24391

Asculai, E.

A METHOD OF RAPID DETERMINATION OF ATMOSPHERIC DIFFUSION PARAMETERS. Oak Ridge National Lab., Tenn., Intern. Symp. Fissio Prod. Release Transport Under Accident Conditions, Oak Ridge, Tenn. April 1965, p. 429-438. 14 refs. (April 5-7.) CFSTI: CONF-650407 (Vol. 1)

The quick primary and subsequent knowledge of the meteorological diffusion parameters, which can be classified and inserted either in predetermined graphs or isopleths, or used to directly calculate the resultant dosages or concentrations, is especially necessary during nuclear reactor accident conditions. The use of standard classifications (stability parameters or categories) may sometimes, due to local effects, be misleading. The following method facilitates the rapid evaluation of the diffusion parameters The main source parameters needed for the diffusion estimates are the mean wind direction, the mean wind speed, and the two standard deviations representing the lateral and vertical dispersions. These last two parameters are given as the product of x(or f(x)) an the standard deviation of the wind direction or inclination with averaging times S and measured over the whole sampling period (T). S is a function of the downwind distance and of the mean wind speed T is either the period of release or the relevant time of exposure. The measuring system incorporated in this method may measure the mean wind direction and standard deviations and may be utilized at various S and T values. The measuring system utilizes relatively a high-frequency sampling of the varying parameter. This is done by the 'chopping' of a varying dc signal at a high rate and feeding the resultant pulses (after amplification) into a multichannel analyzer. Periodic or total results may be taken from the instrument, according to the desired T or S, which may vary over a wide range. The usual output is made through a digital printer, an the results may then be quickly evaluated without great error. A mean direction corresponding to the peak value (usually found at th axis of symmetry) may be obtained quite accurately because of the good resolution of the system. The agreement between the observed and calculated values of the inclination (taken as 0.23 times the width of trace) is quite good and does not depend greatly upon the position of the peak value (some asymmetry and deviation from a normal curve will not cause a sensible error). The values of the inclination for the proper averaging and sampling time are utilized either according to predetermined classifications or directly in the equations of diffusion. The mean wind speed is determined from a wind run (integrator) recorder. This system is also utilized to measure at the same time two variables, and study the shape of the variation. Some other utilizations of the system include climatological, 'gradient,' and flow-around-obstruction studies; some of the results are discussed. (Author abstract modified)

24407

Fuquay, James J., Charles L. Simpson, and W. Ted Hinds

ESTIMATES OF GROUND-LEVEL AIR EXPOSURES RESULTING FROM PROTRACTED EMISSIONS FROM 70-METER STACKS AT HANFORD. General Electric Co., Richland, Wash., Hanford Atomic Products Operation, AEC Contract AT(45-1)-1350, 28p., Jan. 2, 1964. 5 refs. CFSTI: HW-80204

Diffusion data obtained in field experimentation at the Hanford, Washington, AEC site were employed to determine the parameters of Taylor's equation for lateral growth. The lateral growth of a plume can be expressed solely in terms of wind observations taken near the source. This result leads to the derivation of air exposure values from the bivariate normal model accounting for the wind variability characteristic to the Hanford site. The air exposures that are expected from prolonged releases of two, four, eight, and twenty-four hours from a Hanford 70-meter stack during conditions of atmospheric stability are calculated using wind data from the Hanford tower. The results of this analysis are as follows: exposure estimates for the emission periods were generall much lower than those previously derived for Hanford; the latter estimates pertained to emission periods of one hour or less; increasing the period of emission acts to reduce the air exposures; and the distance to maximum exposure for a given release is reduced by the additional dilution which results from prolonging the release. (Author summary modified)

24439

Ohtake, Takeshi

UNUSUAL CRYSTAL IN ICE FOG. J. Atmospheric Sci., 27(3):509-511, May 1970. 7 refs.

The moisture for the formation of ice-fog crystals normally comes from such man-made sources as open water resulting from the dumping of cooling water from power plants, and exhausts from heating plants and automobiles; the unusual shapes of some of these crystals (other than spheres and plates) are described, with emphasis on 14 or 20-faced polyhedral crystals found in an ice fog in Fairbanks, Alaska at a temperature of -47 C. Despite the lack of good evidence, it is possible that these crystals form because the supercooled water droplets freez over such a short time that the crystal does not have enough time to reach an equilibrium state for the development of normal hexagonal and rectangular faces. It is also possible that, due to absorption of air pollutants (dust particles inside or outside the chamber), the growth did not occur onto the most stable hexagonal rectangular surfaces. These crystal shapes were seen only in the largest crystals because of the poor resolving power of the optical microscope, but they may also exist in smaller sizes in ice fogs which previously were considered to contain only spherical crystals.

24486

Bodurtha, F. T., Jr.

CONTROL OF POWER PLANT STACK FMISSIONS FOR CLEAN AIR. Proc. Am. Power Conf., vol. 27:399-411, 1965. 28 refs. (April 27-29.)

A discussion of dispersion, inversions, topography, and fog as they relate to the control of sulfur compounds from stacks is presented. Concentrations of sulfur dioxide from a stack are low near it, but increase to a peak somewhere downwind from it. The magnitude of this peak, all else being equal, depends upon wind speed. The relevant equations relating wind and plume behavior are discussed. Where slow dispersion occurs in a temperature inversion, the maximum concentration at the ground from single stacks of moderate heights will be considerably less than the maximum concentration during normal dispersion. The phenomenon of fumigation after a stack plume is carried aloft at great distances in an inversion is explained. The low wind speed conditions that accompany an inversion should be the major criterion of needed control for low level emissions, once a maximum permissible concentration of SO2 is established. The relationship of topography, and particularly valleys, to dispersion is discussed. Fog droplets tend to concentrate SO2 in the form of sulfuric acid, a condition which often exceeds industrial threshold values. Of the three major episodes that have taken place in the world, all occurred in thick fog, during inversions, and two were in valleys. The medical aspects of air pollution are briefly considered. Theoretical equations describing plume behavior are given.

24509

Culkowski, Walter M.

EFFLUENT FLOW IN NON-STACK RELEASES. Oak Ridge National Lab., Tenn., Intern. Symp. Fission Prod. Release Transport Under Accident Conditions, Oak Ridge, Tenn., April 1965, p. 455-459. 5 refs. (April 5-7.) CFSTI: CONF-650407 (Vol. 1)

Aerial films were made of smoke behavior near two structures, one a practice fire tower and the other an experimental gas-cooled reactor. When a smoke source was placed on the lee side of the former building, a conventional plume was produced most of the time however, the smoke often exhibited a sudden rise and the entire leeward side of the building appeared to be emitting smoke. At suc times, i.e., when the entire building became an 'area' source, it was virtually impossible to detect the location of the true source of smoke emission. A smoke source at the side of the reactor produced not only the conventional plume and 'area' effect but also classical 'vortex shedding,' where a localized turbulent wake is produced, breaks off, and is carried downwind as a decaying vortex. While these problems can be handled mathematically through formulas for source correction, evacuation of personnel during downwind release may be more difficult.

24569

Gifford, F. A., Jr. and D. H. Pack

SURFACE DEPOSITION OF AIRBORNE MATERIAL. Nucl. Safety, 3(4):76-89, June 1962. 96 refs.

A review of the literature is presented on surface deposition, defined as the entire complex of physical phenomena that may result in removal of gases or particles at the air-ground interface, including gravitational settling, adsorption, particle interception (impaction), diffusion, and possibly chemical and electrostatic effects. The results of several important series of experiments by various investigators are summarized and the data tabulated, including deposition experiments with I(131) vapor, dry deposition of activity on nuclei on horizontal surface, and deposition velocities from tracer material-balance experiments. Theoretical and experimental aspects of deposition velocity calculations are discussed. It is concluded that a clear distinction has been shown between the rate of removal of chemicall active material and of inert material of similar size; vegetation, specifically grass and sagebrush, effects removal at rates an order of magnitude larger than those measured on bare soil or flat- plate collectors. Subjects for future investigation are noted.

25075

Royal College of Physicians London (England), Committee on Smoking and Atmospheric Pollution

AIR POLLUTION AND HEALTH. London, Pitman Medical and Scientific Publishing Co., Ltd., 1970, 80p. 142 refs.

Air pollution in England as a result of the burning of coal has been a problem for hundreds of years. The major pollutants in this case are smoke and sulfur dioxide. These pollutants, when combined with a temperature inversion, resulted in a pollution episode that was responsible for the death of approximately 4000 persons in England. As a result of this disaster, attempts have been made to discover the relationship between air pollution and such health effects as bronchitis, pneumonia, and lung cancer. Experimental work on the effects of inhaled particles and gases on the lungs is discussed. Cigarette smoking is linked to an increased mortality rate from bronchitis in men. Differences between urban and rural health statistics are considered. Another major source of pollution is the automobile, which emits large quantities of oxides of nitrogen and carbon monoxide. These pollutants result in the phenomenon known as 'Los Angeles smog.' Air pollution can only be prevented by controlling the main sources, which are domestic heating, industry, and vehicular. The effects of British legislation, including the Clean Air Act of 1956, are described.

25212

Weber, Erich

DETERMINATION OF THE LIFETIME OF SO2 BY SIMULTANEOUS CO2 AND SO2 MONITORING. Preprint, International Union of Air Pollution Prevention Associations, 11p., 1970. 16 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper CP-25F.)

Preliminary results are presented for the continuous monitoring of sulfur dioxide and carbon dioxide concentrations in Frankfurt on the Main, together with calculations of the residence time of SO2. The area's principal sources of SO2 and CO2 are power plants and space heating. The most significant mechanisms influencing the residence time of SO2 appear to be absorption on surfaces; oxidation to sulfates, mostly on wet surfaces of aerosols and water droplets; rainout; and washout. Almost 70% of the original SO2 in a power-plant plume was absorbed or oxidized during a travel time of 17 min. The average residence time of SO2 is probably 10 min to one hour. (Author abstract modified)

25229

Roberts, J. J., J. E. Norco, A. S. Kennedy, and E. J. Croke

A MODEL FOR SIMULATION OF AIR POLLUTION TRANSIENTS. Preprint, International Union of Air Pollution Prevention Associations, 54p., 1970. 36 refs. (Presented at the International Clean Air Congress 2nd, Washington, D. C., Dec. 6-11, 1970, Paper ME-39A.)

A multi-source, urban atmospheric dispersion model has been developed which describes transients such as morning transitions in atmospheric stability and mixing layer height. The dispersion model has been validated by comparison with over 10,000 hourly averages of sulfur dioxide monitored by the Department of Environmental Control of the City of Chicago. For example, the model accounts for 50% of the variance in 6-hr averages of observed data and 70% of the variance in 24-hr averages. Of particular significance is the capability of the model to describe 'area sources' as volumetric clouds of pollutant and thus to evaluate the effect of these sources on dose points within as well as external to the area. The atmospheric transport kernel in the model describes the instantaneous release (delta function) of pollutant, advection according to piecewise constant hourly wind vectors, and Gaussian diffusion about the centroid. Simulation of continuous plumes is achieved by integration in time of this point source Green's function. This paper presents brief descriptions of the transport theory and other computerized algorithms central to the dispersion problem. Acquisition of an emission inventory is reviewed with particular emphasis on a method for simulating hourly outputs from electric utilities. Statistical results of the validation studies are presented. (Author abstract)

25815

Thomas, Fred W.

TVA AIR POLLUTION STUDIES PROGRAM. Air Repair, 4(2):59-64, Aug. 1954. 8 refs.

Air pollution studies at Tennessee Valley Authority steam plants are divided into two parts: pre-operational and post-operational. The first phase provides base-line information against which actual plant operation can be checked; it includes obtaining meteorological data where little or no weather data are available and the collection and chemical analysis of samples from selected trees in the area. Post-operational studies include continued meteorological observations, analysis of plant operating data, routine monitoring, biological surveys, and special studies on dispersion. These special studies have led to a method for estimating effective stack height and critical wind speed, modification of a portable Titrilog for mobile monitoring, adoption of lead peroxide cylinders as a practical and economic means of approximating cumulative SO2 activity at any point, and the development of deposit gauges that classify fly ash according to source direction.

25935

Gifford, F. A., Jr.

USE OF ROUTINE METEOROLOGICAL OBSERVATIONS FOR ESTIMATING ATMOSPHERIC DISPERSION. Nucl. Safety, 2(4):47-51, June 1961. 9 refs.

Based on the generalized Gaussian dispersion formula, methods are presented for estimating the vertical dispersion and the horizontal dispersion coefficients for a cloud or plume (as a function of distance from the source) under neutral meteorological conditions and different degrees of stability and unstability. The use of dispersion estimates should be desirable in both nuclear reactor safety studies and other air pollution problems.

26141

Hino, Mikio, Masao Homma, and Toshio Senshu

DIFFUSION OF SMOKE FROM A HIGH STACK. Phys. Fluids Suppl., 10(9):S267-S269, 1967. 8 refs.

Experiments on smoke diffusion from high stacks of thermal electric power stations indicate that the maximum time-average gas concentration at ground level decreases within a range of sampling times from 1 to 5 hr, inversely proportional to the 1/2 power of the sampling time as predicted from turbulence theory by Inoue, Ogura, and Hino. The structural height of the stack was 150 m, but the effective height due to buoyancy and momentum rise was 300 to 450 m. A method of radio-activation analysis of tracer particles was developed, and meteorological data up to 500 m were obtained by means of two moored balloons, as well as pilot balloons and anemometers. The diffusion formulas generally used give a higher estimation of ground-level concentration than the observed. The height of the atmospheric surface boundary layer is greatest at neutral condition, becoming less with a deviation from neutral to stable or unstable stratification of the atmosphere. (Author abstract modified)

26267

Hasek, Milan

THE DIFFUSION OF SMOKE GASES FROM FACTORY CHIMNEYS AND ITS METEOROLOGICAL CONDITIONS. Stud. Geophys. Geod., vol. 8:82-96, 1964. 31 refs.

A knowledge of the turbulent energy balance in different parts of the spectrum is required for a study of the diffusion of a smoke plume. The smoke entering the atmosphere is acted on not only by the dynamically conditioned effects of turbulent mixing (mechanical mixing) but also by turbulence which causes mainly the removal of eddies in the vertical direction (thermic turbulence). Time changes in concentration on the basis of changes in the turbulent spectrum are discussed and methods of determining turbulent parameters (the dimensionless meteorological exponent and the virtual coefficients of diffusion) are analyzed. A formula is derived for calculating maximum surface concentration which can be applied for hourly intervals during constant flow in a selected 10-min interval for the average 10-sec directions of flow. Field measurements of sulfur dioxide in the neighborhood of a power plant and theoretical computations yielded satisfactory agreement.

F. BASIC SCIENCE AND TECHNOLOGY

00105

W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and R. E. Stickney

RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION (QUARTERLY TECHNICAL PROGRESS REPT. NO. 5, SEPT. 1 - NOV. 30, 1964). Massachusetts Inst. of Tech., Cambridge, Research Lab. of Electronics. Dec. 15, 1964. 24 pp. CFSTI: AD 610 673

This report gives a technical review of progress covering the period September 1 November 30, 1964. Section I states the research aims of the Group. Section II gives a resume of progress and future plans in each of the current areas of investigation. Section III gives details of phases of these investigations which have been completed. The research program is a continuing effort to explore and develop new concepts in energy conversion. At the present time, 2 forms of closed-cycle magnetohydrodynamic power-generation systems and thermionic energy converters are being investigated. Current research topics and objectives are outlined. Author Abstract)

00530

W. O. Negherbon

SULFUR DIOXIDE, SULFUR TRIOXIDE, SULFURIC ACID AND FLY ASH: THEIR NATURE AND THEIR ROLE IN AIR POLLUTION. Hazleton Labs., Inc., Falls Church, Va. June 1966. 1218 pp.

This monograph discusses the following: (1) Historical considerations; (2) Guidelines for the study of air pollution; (3) Physical and chemical properties of SO2, SO3, and H2SO4; (4) Meteorological considerations; (5) Anatomical and physiological considerations; (6) Deposition and retention of aerosol particles in the respiratory tract; (7) The effects of SO2 and H2SO4 on plants; (8) The effects of SO2, SO3, and H2SO4 mist on man and animals; (9) Fly ash origin, nature, and possible effects; and (10) Removal of pollutants from flue gases. The bibliography includes 2264 references.

01379

C.P. Joyce L.A. Miller

THE ENGINEERING CHALLENGE OF TOTAL ENERGY. Columbia Gas System Service Corp., Columbus, Ohio 1965. 6 pp. (Presented at the Oil and Gas Power Conference and Exhibit, Houston, Tex., Apr. 4-8, 1965, of the American Society of Mechanical Engineers, Paper No. 65-OGP-15.)

Broadly, total-energy means conversion of energy at the point of use. Specifically, TEC furnishes all energy, i.e., the heating, cooling, and electrical requirements, for a structure or an industrial plant. Natural gas is burned in a reciprocating or gas-turbine prime mover to furnish electric energy, and the waste heat is used for the heating and cooling requirements. If additional energy is needed for heating and cooling, a supplemental boiler is included in the energy package. An economic advantage should be possible because of the high efficiencies available through an on-site energy-conversion system. The feasibility study translates the efficiency advantage of total-energy systems intoan understandable profit picture for the customer. The detailed study is complex, costly and time-consuming. Reductions in both cost and time of studies are proposed through the use of computer techniques, which additionally provide a more penetrating analysis. (Author abstract modified)

01380

H.F. Burgart

TOTAL-ENERGY SUCCESSES TO DATE IN NORTHERN ILLINOIS. Northern Illinois Gas Co., Aurora, 1965, 8p. (Presented at the Oil and Gas Power Conference and Exhibit, Houston, Tex., Apr. 4-8, 1965, of the American Society of Mechanical Engineers, Paper No. 65-OGP-14.)

'Total energy' is a concept whereby (a) all the energy requirements of a power-generation installation are satisfied with a single fuel; and (b) the highest possible percentage of the energy available in that fuel is converted to electrical energy. The means employed to fulfill the total energy concept in several natural-gas fueled power-generation installations are discussed. (Author abstract)

01852

C. R. McCann, J. J. Pfeiffer, A. A. Orning, W.H. Oppelt

REPORT ON COMBUSTION TRAILS SPENCER LOW-ASH COAL. Preprint. 1965.

The Spencer low-ash coal was burned with varying degrees of success as pulverized fuel, as liquid fuel with air atomization, and as solid fuel in a vortex unit with total overfire air. Combustion as a pulverized fuel was successful, except that prolonged burning, needed for estimates of combustion efficiency, failed because of coking of the burner tube. High dielectric character and resulting electrostatic charges on the fuel were contributing factors. Combustion as liquid fuel failed because of the restricted range between fluid and devolatilization temperatures. It appears that such combustion is possible, but considerable development work would be required. Exploratory trials in the vortex unit indicated good operation if means for continuous fuel feed was provided. Present equipment is designed for batch operation only.

02743

R. D. Harris

THE OCCURRENCE OF SULFUR IN BITUMINOUS COALS AND METHODS OF REMOVAL. Preprint. (Presented at the Technical Sales Conference, National Coal Association and Annual Meeting, Bituminous Coal Research, Inc., Pittsburgh, Pa., Sept. 16, 1965.)

After investigationg various possible techniques for cleaning pulverized coal, it was concluded that two or more stages of cleaning would be necessary. For two-stage cleaning, some 50 percent of the coal (that which is completely pulverized in one pass through the mill) would be partially cleaned by an efficient air classifier and the coarser material rejected by the classifier would be more thoroughly cleaned, and then the clean fraction would be recycled. A motorized two-stage air classifier was tested in a small pilot-scale installation to determine if its operation was flexible enough for power station application and if it was suitable as a primary pyrite separator. Reject fractions with a minimum dust content were produced with a wide range of feed rates and varying air rates; therefore, an efficient classifier is considered suitable for power plants. Tests showed that significant pyrite removal is possible by cleaning the fraction rejected by the classifier at 1.6 specific gravity and returning the float fraction to the mill. However, the beneficiation tests indicated that two-stage cleaning is more beneficial for coals that were previously cleaned at the mine. No commercial processes for cheaply cleaning the recycle from the classifier are available, and past efforts to develop such processes as electrostatic separation for coal cleaning have been unsuccessful. It is felt, however, that the use of the air classifier to reduce by 50 percent the amount of fine coal to be cleaned and to provide a relatively monosize feed makes economical fine coal cleaning more realistic. (Author summary)

04827

H. J. Gluskoter

CLAY MINERALS IN ILLINOIS COALS. J. Sediment. Petrol. 37, (1) 205-14, Mar. 1967.

It is hoped that study of clay minerals contained in coal of southern Illinois will resolve some of the paleogeographical and environmental questions pertaining to this area. Clay minerals were isolated from coal by low temperature ashing, using oxygen activated by a radio frequency discharge. No changes were detected in the clay minerals during ashing except for some instances of dehydration. Irreversible changes were not observed in any clay mineral tested. Clay minerals found in the Illinois coals consisted of illite, kaolinite, a random mixed layer illitemontmorillonite, montmorillonite, and chlorite. Chlorite was observed in only one sample and in trace amounts. The clay minerals from Herrin (No. 6) Coal sampled in southwestern Illinois contain less illite relative to mixed layer material than those from the coals in southeastern Illinois. Although authigenic kaolinite is commonly observed, there is also a tendency for the coals that contain relatively larger amounts of illite than mixed layer minerals to contain greater amounts of kaolinite. The areal distribution of the clay minerals in the Pennsylvanian coals of southern Illinois is thought to be primarily the result of introduction of sediments from the east and northeast, and of the reaction of these clay minerals to the coal swamp environment. Without further data, it is not possible to determine whether the contribution of provenance or of transport and diagenesis on the clay mineral assemblage and distribution of the clay minerals is the more important.

04939

A. B. Walker

INFORMATION REQUIRED FOR SELECTION OF ELECTROSTATIC AND COMBINATION FLY ASH COLLECTORS; METHODS OF ANALYSIS FOR CHEMICAL PHYSICAL, AND ELECTRICAL PROPERTIES OF FLY ASH (INFORMATIVE REPORT NO. 2). J. Air Pollution Control Assoc. 15, (6) 256-60, June 1965.

The information required for specification or request for bids for fly ash collectors are presented. The APCA Standard Methods for determination of the following properties of fly ash are presented: (1) bulk resistivity of dry particulated in the laboratory; (2) bulk electrical resistivity of dry particulates in situ; (3) water soluble content; (4) water soluble sulfate content (with an alternate method); and (5) loss on ignition.

07059

E. J. Baier and R. Diakun

COMPARISON OF DUST EXPOSURES IN PENNSYLVANIA ANTHRACITE AND BITUMINOUS COAL MINES. Am. Ind. Hyg. Assoc. J. 25 (5), 486-80 (Oct. 1964).

Results of a two-year study of dust conditions in Pennsylvania coal mines, including 24 anthracite and 14 bituminous coal mines, are presented. Determinations of airborne concentrations, particle size distribution, and free silica content were made on more than 1400 samples. Dust in anthracite mines had, in general, more free silica and smaller particle size. Mechanized mines were not significantly different from nonmechanized mines in dust production. Exceptions to these generalizations are discussed. (Authors' abstract)

08941

Stewart, Robert F. and William L. Farrior, Jr.

NUCLEAR MEASUREMENT OF CARBON IN FLY ASH. In: John H. Faber, John P. Capp, and John D. Spencer (compilers), Fly Ash Utilization. BM-IC-8348, Washington, D.C., Bureau of Mines, 1967, p. 262-270. 7 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The carbon content in fly ash was measured utilizing the neutron activation method. Fly ash samples were placed around the detec tor in the direct path of the neutrons. Fast neutrons from the source penetrate the fly ash producing inelastic and capture gamma rays, some of which are detected by the scintillation crystal Electrical pulses produced by the detector are proportional to the energy of these gamma photons. The latter are then measured by a multichannel analyzer and sorted by amplitude to represent the gamma ray spectrum. Three different fly ashes, ranging from 2.7 to 16.4 percent carbon, were tested. These fly ashes are typical products from powerplants firing pulverized bituminous coal from both strip and deddp coal mines. Weighed samples of each fly ash were placed in the sample container and measured for 100-minute counting periods. Initially, 12-pound samples were tested, but improved precision was subsequently obtained with 20-pound samples. Approximately equal volumes were obtained by shaking the fly ash in the container to a bulk density of about 20 pounds per cubic foot. The results indicate that carbon content can be measured with a precision of at least 0.5 percent carbon by this method. Considerably better precision would be expected with control of bulk density.

08943

Minnick, L. John

REACTIONS OF HYDRATED LIME WITH PULVERIZED COAL FLY ASH. In: John H. Faber, John P. Capp, and John D. Spencer (compil- ers), Fly Ash Utilization. BM-IC-8348, Washington, D. C., Bureau of Mines, 1967, p. 287-315. 23 refs. (Presented at the Edison Electric Institute, National Coal Association, Bureau of Mines Symposium, Pittsburgh, Pa., March 14-16, 1967.) GPO: 0-268-468

The investigation of lime-fly ash reactions under several conditions of curing has shown that variations between limes and between bly ashes play a significant role in the nature of the chemical reactions. It is further indicated that the major reactants with in the limes comprose calcium hydroxide and magnesium oxide and that the presence of carbonates or magnesium hydroxide makes no significant contribution to the pozzolani reaction at ambient temperatures. In the case of fly ashes, most of the mineral constituents are nonreactive (also at ambient temperature). The data which are developed by means of X-ray, DTA, and microscopic examination are in substantial agreement, and indicate that the amorphous glassy materials within the fly ashes reac to form com plex silicates and aluminates. A number of the compounds produced have been identified and other possibilities are suggested particularly with respect to the formation of compounds containing mag nesium ions. Evidence of physical reactions manifested by volume change and the development of cementitious bonds (resulting in monolithic structures) has shown good correlation with the chem ical reactions that have been identified in the study. Effects of finess, chemical purity, and chemical reactivity, have been ob served to function in much the same manner as has been experienced in field applicaitons utilizing lime and fly ash in various compositions containing soil and aggregate. The continuing re search which is in progress should be useful in developing a more complete understanding of the role of calcium oxide and magnesium oxide, particularly when present as an integral part of the fly ash composition. The evidence of the reactivity of the magnesium oxide constituent in monohydrated dolomitic lime is of considerable significance and will also require additional study.

09064

Csaba, J. and M. M. Baum

COMBUSTION OF SINGLE PULVERIZED-COAL PARTICLES, PART 1. J. Inst. Fuel, 40(315):163-169, April 1967. 8 refs.

An analogue computer study has been carried out into the combustion behaviour of single pulverized-coal particles. The study has shown that it is ill-advised to extrapolate burning times obtained on large particles, which burn at a near constant temperature, to small particles for which the burning temperature is far from steady. It has also been shown that although during combustion with infinite excess oxygen the temperature difference can be very high between the particle and the surrounding gas, combustion with more practical values of excess oxygen does not cause an excess temperature of more than a few hundred degrees Celsius. (Authors' abstract)

09769

Shale, C. C., J. H. Holden, and G. E. Fasching

ELECTRICAL RESISTIVITY OF FLY ASH AT TEMPERATURES TO 1,500 DEG. F. Department of the Interior, Washington, D. C., Bureau of Mines, RI-7041, 17p., March 1968. 15 refs.

Electrical resistivities for various coal ashes in air and in a nitrogen atmosphere are given over the range 100 deg. to 1,500 deg. F. Resistivity of low-carbon ash in air is very high at low temperature, rises to a maximum at about 250 deg. F., decreases very rapidly with increasing temperature to about 800 deg. F., then decreases gradually to approach an asymptote at 1,500 deg. F. Resistivity of high-carbon ash in air follows this same general trend at values which are much lower and are proportional to the carbon content. After the carbon has been burned off, resistivity of the remaining ash approaches the high values corresponding to low-carbon ash of similar chemistry. Experiments show the effects of temperature, particle size, chemical content, and compressibil ity on the resistivities of four fly ashes of widely different chemical composition in the temperature range proposed for coal fired turbines. Resistivities of all low-carbon ashes tested fall in the range 10 to the 6th power to 10 to the 7th power ohm cm at 1,500 deg. F. adn should be removable by electrostatic precipitat ors. Ashes containing carbon in excess of about 8 percent, how ever, have low resistivity (as determined in nitrogen), especially at high temperatures. Therefore, high-carbon materials may not be collectable in precipitator because the resistivity is below the minimum value necessary for precipitation. Consequently, high carbon residues from partial combustion of coal probably could not be removed effectively at high temperatures. (Authors' abstract, modified)

09967L

Reid, William T.

RECOMMENDATION FOR THE USE OF LIMESTONE AND DOLOMITE IN BOILER FURNACES. In: Fundamental Study of Sulfur Fixation by Lime and Magnesia. (Research Report.) Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Contract PH-86-66-108, p.23-24, June 30, 1966. 23 refs.

This paper is the third of three parts of a study undertaken to identify the basic factors involved in the captures of SO2 by limestone or dolomite added with the fuel, or blown separately into the hot flue gases of central-station boiler furnaces. The purpose of the study is to define the limiting conditions under which the reactions can occur. This section of the report relates the thermochemical and kinetics sections to the practical problems of using limestone and dolomite most effectively in boiler furnaces. It is intended as a guide to future tests, either on a relatively small scale in the laboratory, or in experimentation in operating boilers. Results of many thermochemical calculations are listed in the appendix.

10422

A. K. Chatterjee, and B. K. Mazumdar

METHYL GROUPS IN COAL. Fuel, 47(2):93-102, March 1968. 13 refs.

The contention that methane formed during low temperature pyrolysis (600 degrees C) owes its origin almost exclusively to the methyl groups in coal and that such methane formation (including small proportions of ethane) represents the maximum or true measure of the methyl content is re-examined in the light of the pyrolysis behaviour of nitro-coals. Nitration is believed by the authors to cause selective oxidation of the methyl groups to carboxyl groups (apart from the introduction of a considerable proportion of nitro-groups in coal). It has now been found that such nitro-coals on pyrolysis at 600 degrees C yield no methane and little of other hydrocarbons, but much carbon dioxide, the volume of which after due corrections appears to be of a magnitude similar to that of the methane obtainable by pyrolysis at 600 degrees C of the corresponding untreated coals. Further, nitro-coals by reductive decarboxylation followed by thermal decarboxylation at 350 degrees C for completeness yield a volume of carbon dioxide virtually equal to that of the methane obtainable by pyrolysis of the untreated coals. These findings appear to confirm the authors' previous hypothesis of the origin of methane during pyrolysis at 600 degrees C, and hence the validity of assessment from this of the methyl content in coals.

10429

Juntgen, H. and K. H. Van Meek

GAS RELEASE FROM COAL AS A FUNCTION OF THE RATE OF HEATING. Fuel 47(2):103-117, March 1968. 10 refs.

Fundamental work on the kinetics of coal pyrolysis at continuously rising temperatures is described. The theory of non-isothermal reaction kinetics is used to calculate the dependence of gas releasing reactions on temperature, taking as parameters the reacti order, the activation energy, the frequency factor and the rate of heating. Furthermore, it is possible to calculate the reaction parameters from curves established by measurements under non isothermal conditions. This theory was checked against the thermal decomposition of simple organic molecules and has been found to be good agreement with experiment. The simplest curves of gas emission rate from coal as a function of temperature are obtained for higher gaseous hydrocarbons. This type of curve is interpreted in terms of a single reaction, whereas the release of methane and hydrogen is more complicated. To show the influence of heating rate, the release of ethane from a finely-ground coal (19.15 VM) was measured at different values between 0.01 and 100,000 deg. C/min. These experiments agreed well with the theory, assuming a first order law with a mean activation energy of 42.1 kcal/mol and a mean frequency factor of 10 to the 11th power per min. Also, the theoretically calculated shift of the reaction to higher temperatures with increasing rates of heating was exactly confirmed by experiment. (Authors' abstract)

11135

Anon.

FURNACES FOR THE STUDY OF PARTICLE REACTION RATE. B.C.U.R.A. Brit. Coal Util. Res. Assoc.) Gaz., No. 65:13-15, 1968

Furnaces have been developed to measure the rates of devolatilization and combustion of pulverized-coal particles suspended in a gas of controllable composition and temperature. They have been used to measure the reaction rates of coals and are also suitable to measure particle reaction rates of other combustible materials. Operated at atmospheric pressure in a temperature range of 600 K to 2800 K, they can be used to determine reaction rates on particle sizes from 20 to 100 microns.

11163

E. Raask

CENOSPHERES IN PULVERIZED-FUEL ASH. J. Inst. Fuel 41 (332): 339-349, (Sept. 1968).

The lightweight ash particles (cenospheres) which float on some power station ash lagoons are hollow microspheres of silicate glass, 20 to 200 microns in diameter, with non-porous shells 2 to 10 microns thick. Evolution of CO2 and N2 inside particles of fused silicate glass during their stay in the boiler results in their expansion to cenospheres. The gas evolution is catalyzed by iron oxide. Author's abstract

11257

Welsh, Harvey W.

FUTURE TRENDS IN ENERGY CONVERSION SYSTEMS. Preprint, S.A.E. (Society of Automotive Engineers) New York, 32p., 1966. 44 refs. (Presented at the Farm, Construction and Industrial Machinery Meeting, Milwaukee, Wis., Sept. 12-15, 1966, Paper 660603.)

Present and future trends in utilization of energy sources as well as development of various types of powerplant systems are discussed. Types of energy, their limitations, cost, operations, and requirements related to conversion systems are reviewed. Some of the sources mentioned are solar energy, nuclear and isotopes, thermal storage, and chemical energy. Present day energy converters analyzed are thermomechanical conversion systems such as the Otto, Diesel, and Brayton cycles. Also considered as engines of the future are direct conversion systems such as the storage battery, thermoelectric, and fuel cell systems. It is concluded that no one type system will predominate over all others; rather there will be continued effort to match the power converter to the overall system requirements in the most effective manner. (Author's abstract, modified)

11722

Saks, S. Ye.

HYDRAULIC RESISTANCE DURING TURBULENT MOVEMENT OF FINELY DISPERSED PARTICULATES. ((Gidravlicheskiye soprotivleniya pri turbulentnom dvizhenii tonkodispersnykh aerosmesei.)) Text in Russian. J. Inzh. Fiz. Zh., 14(4):633-638,April 1968. 7 refs

A mathematical expression is derived for the relationship between mean-square turbulent velocity of a solid particle and the angular frequency of turbulent pulsations, the energy loss per unit time per unit mass of medium, and the particle relaxation time. Application of this equation to the theoretical analysis of turbulent stresses produced by momentum transfer in a stream of finely divided particulates, where the mean flow velocity (Vm), freefall velocity, (u*) and tube diameter (D) are known, permits determination of the coefficient of excess hydraulic resistance (K). In an experiment on the airborne movement of coal dust in a vertical tube (D=5.4 cm) the relationship between the square root of 1/k minus 1 and Vm u*/D was linear for both anthracite (density=1810 kg/cu m; mean particle diameter=0.0425 mm; u* =0.077m/sec) and soft coal (density=1660 kg/cu m; mean particle diameter=0.044 mm; u*=0.078 m/sec).

11782

J.F. Jones, M. R. Schmid, M. E. Sacks, Y. Chen, C. A. Gray, R. T. Eddinger

CHAR OIL ENERGY DEVELOPMENT. (FINAL REPORT.) FMC Corp., Princeton, N. J., Chemical Research and Development Center, Contract 14-01-0001-235, 228p., Jan.-Oct. 1966.

Under Project COED, a process has been developed for more effectively utilizing coal. The process is the multistage fluidized-bed pyrolysis of high-volatile bituminous coals to produce oil, gas, and char. Catalytic hydrotreating of the oil yields a synthetic crude oil suitable as a petroleum refinery feedstock. The product gas can be reformed to produce a high Btu pipeline gas or hydrogen. The char product would be used as boiler fuel for power generation. Experimental work showed that the sulfur content of COED char from Illinois No. 6-seam coal could be reduced from 3 percent to less than 1 percent by hydrogenation at 1600 degrees F. Process economics require the high-temperature removal of hydrogen sulfide from the gas phase. The desulfurization reaction is severely inhibited by concentrations of hydrogen sulfide as low as 0.5 mole percent. Calcined limestone or dolomite appear to be the most commercially promising hydrogen-sulfide acceptors. The commercial potential of the COED process was evaluated for a plant processing 3.5 million tons of coal per year using data from the experimental COED unit. With hydrogen as the product gas, the return on investment for plants utilizing four of the five coals tested in the unit varied between 22 and 35 percent before taxes. The return for a plant utilizing the Wright coal showed only 15 percent before taxes. This low value reflects the lower volatile-matter content of this coal. For these estimates, product credits of $3 per barrel of oil, 25 cents per thousand cubic feet of hydrogen, and char at 90 percent of equivalent coal value were used.

13027

Wright, Fred D.

ROCK MECHANICS AND COAL MINING. Mining Engineering, 21(2):112- 113, Feb. 1969. 34 refs.

Research by a number of investigators on mine pillars, longwall mining, and roof support is discussed. Horino (U.S.B.M., R.I. 7155, July 1968) tested approximately 400 model pillars of limestone, sandstone, and granite in uniaxial compression to determine the effect of planes of weakness and their inclination on pillar strength. Results indicated that strength decreases rapidly as the angle from the horizontal to the plane of weakness increases from 30 to 57 deg. and that the number of planes has only a minor effect on strength. A project to determine the mechanism of brittle fracture of rock and to determine the effect of specimen size on the compressive strength of coal concluded that the width to height ratio did affect pillar strength, but only up to a point. Select U.S. and British mines are discussed as examples for and against longwall mining. One case describes severe bouncing which ceased when the room and pillar system was replaced by a longwall system. Production capacity is analyzed for both systems. Beam and pressure arch theories correlated to field experience by Adler (Mining Congr. J., p.58-67, March 1968) are reviewed. The roof-control program of the North American Coal Company lead to improvements in setting timbering and bolting standards, in bolt recovery, and in faster and simplified bolting methods. The Bureau of Mines' work in hydraulic mining and detonation complications was also mentioned.

13191

Conklin, Edwin R.

1968 ANNUAL STATISTICAL REPORT: PART I. Elec. World, 169(4):81- 96, Jan. 22, 1968.

Current and future capital expenditures of investor-owned power companies, federal agencies, and municipal and rural electric cooperative systems are reported in text and tables. Included are plant expenditures for generation, transmission, distribution, maintenance, and new expenditures for lines (overhead and underground) and substations. Tabulated data cover 1968 budgets, long-range (1968-1972) budgets, transmission and distribution construction, capital spending by ownership and region, transmission and distribution expenditures by ownership and region, and transmission and distribution construction by ownership and region. Capital spending by Canadian utilities is also surveyed. Despite continued high interest rates, record expenditures are indicated. For 1968, the industry budgeted $8.8 billion, one billion more than 1967 and an increase of 12.8%. Though an increase in nuclear plant spending is reported, fossil-fueled plants will account for 61.2% of the total expenditures for 1968. Hydroelectric generation continues to decrease as potential sites become more scarce.

13400

Evans, R. Keith, Sheldon D. Strauss, and Rene J. Bender

PUTTING FUELS TO WORK. Power, 112(6):S26-S37, June 1968.

There are three principal steps in the combustion process: fuel must be prepared for injection into the furnace; fuel and air must be brought together in the correct proportions and at the right temperature for ignition and combustion; and heat produced by combustion must be transferred to the boiler surfaces. To a greater extent than liquid or gaseous fuels, coals range over a wide spectrum of properties. Since the characteristics of coal vary both physically and chemically, two analyses are required to give a true picture of any coal sample. Ultimate analysis shows the fuel's exact chemical composition, without considering the physical form in which various compounds appear. Proximate analysis determines the sample's percentage of moisture, volatile matter, fixed carbon, and ash. Several types of equipment are used in the combustion process including oil burners, stockers, and pulverizers. When dealing with uranium as a fuel for nuclear reactors, the radioactivity of the fission products must be considered. The fuel rods are encased in alloys of zirconium to prevent these products from passing into the general environment.

13411

Frey, D. J.

DE-ASHED COAL COMBUSTION STUDY. Dept. of Interior, Washington, D. C., Office of Coal Research, Contract 14-01-0001-417, 25p., Oct. 5, 1964.

Evaluation of the burning characteristics of low-ash coal containin 59.2% volatile matter, 40.6% fixed C, and 0.15% ash was carried out by firing in existing test equipment in both its solid and liquid states, using commercially acceptable procedures for firing heavy oils and pulverized coals. The base coal was dissolved in a solvent, filtered to recover most of the ash, and then heated to recover a portion of the solvent. The physical properties of the de-ashed coal could be altered by adjusting the amount of solvent left in the coal. The coal was pulverized to a fineness in the range of 70-75% through 200 mesh and fed into the test furnace (preheated to 1600-1800 F) at the rate of 133 lb/hr, along with about 70,000 btu/hr of igniter gas. Test duration was 50 min, tota heat input was 2,070,000 btu/hr, with an excess air of 18-20%. It was concluded that the combustion characteristics of the de-ashe coal was essentially the same as those of high or medium volatile bituminous coals. Based on the packing characteristics observed, it is suggested that storage of pulverized coals should be avoided and that plugging and packing problems should be anticipated in systems utilizing this fuel. Results of the liquid state studies indicated that problems would be limited to handling and control techniques. It is recommended that heating should be carried out under pressure in a closed system, all equipment contacting the coal be heated to over 350 F, and steam-atomizing oil guns be used to eliminate the need to heat gun components. Provisions must be made to purge all lines and valves of liquid coal for extended shutdowns.

13487

Fukuma, Shin-ichi and Kazumi K. mei

DRY-SYSTEM FLUE GAS DESULPHURIZATION PROCESS (DAP-MN PROCESS) FOR SO2 REMOVAL. Jap. Chem. Quart., 4(3):12-14, July 1968.

The DAP-Mn process for desulfurization of flue gases has the following properties; it removes SO2 efficiently and economically; recovered by products are of marketable quality; the absorbent has long-term operation and can operate reliably with sharp load fluctuations; consumption of absorbent is minimal and SO2 removal is accomplished without a sharp pressure drop; and no major change in the boiler structure is required. After successful laboratory tests in 1963, this desulfurization process which uses manganese oxide and ammonia to make ammonium sulfate from flue gases was tested at a pilot plant in Japan. A semicommerical plant capable of treating gases from a 55 MW power plant has since been constructed and is being test-run in the compound of Chubu's Yokkaichi station. The process occurs three steps: SO2 removal, absorbent regeneration, and by product treatment. Test results indicate a desulfurization rate of 90% at a 1968 cost of $1/ton of fuel oil.

13572

Nicholls, P. and W. T. Reid

VISCOSITY OF COAL-ASH SLAGS. Trans. ASME (Am. Soc. Mech. Engrs.), Vol. 62, p. 141-153, Feb. 1940. 8 refs.

A viscometer for measuring the viscosity of coal-ash slag up to 2900 F is described. Investigations using the instrument show that slags in only a relatively small portion of the field of compositions of coal ash have the melting characteristics of glasses and that, for most compositions, there is a distinct liquidus point. From the limited data available for this progress report, plots for viscosity are given for 2800,2600,2400, and 2200 F, as well as showing the liquidus lines for each temperature. The relation between flow temperature, as determined in earlier investigations for use with slag-tap furnaces, and viscosity and liquidus temperature is derived. When complete trilinear diagrams are available, accurate predictions can be made on the effect of mixing the ash of two coals or of the addition of the main constituents. Predictions of the relative fusion and clinkering characteristics of coals from the softening temperatures of their ashes may give erroneous comparisons, but the initial and fluid temperatures are an additional guide. (Authors' abstract modified)

13573

Whelan, P. F.

FINELY DISSEMINATED SULPHUR COMPOUNDS IN BRITISH COALS. J. Inst. Fuel, 27(164):455-464, Sept. 1954. 5 refs.

Studies of the occurrence of S compounds in coal below 0.5 in. are described. Iron disulfide deposited simultaneously with coal matter has the marcasitic structure and exists in the mature coal as widely distributed grains about one micron in size, and concretions of up to 100 microns of marcasite heavily impregnated with coal. Iron disulfide is present in cleats and other cavities. Its crystal structure is that of pyrite and is considered to be of secondary origin. Froth flotation investigations showed that none of the specific depressant reagents for pyrite known to the mineral dressing industry effectively prevented the appearance of finely divided marcasite in clean coal froths. The degree of S contamination of the clean coal, however, can be controlled by careful adjustment of the frothing reagent quantity and by using lime in carefully controlled amounts.

13601

Parry, V. F.

LOW TEMPERATURE CARBONIZATION OF COAL AND LIGNITE FOR INDUSTRIAL USES. Combustion, 25(9):38-42, March 1954. 1 ref. (Presented at the American Institute of Chemical Engrs. Annual Meeting, New York, Dec. 1953.)

Attempts to develop dried lignite and char for use as direct fuels for power generation were reviewed. When coals having ASTM classifications up to and including high volatile C bituminous were carbonized, the heating value of the pure char was 14,000 Btu/lb, because all the water and much of the oxygen has been eliminated. Pure char thus produced was characterized by high reactivity and ease of ignition. A prototype lignite drier installed in Rockdale, Texas in 1952 is described and its drawbacks discussed. When dried lignite is used as fuel, it is believed that two driers will be capable of supplying fuel requirements for an 80,000 kw unit. A prototype carbonizing unit, a heat electrostatic precipitator, was also considered and a diagram presented. Tar produced by this operation will be chemically investigated as soon as sufficient quantities are available.

13620

Stouff, M. L.

STOUFF'S SUSPENSION COMBUSTION HEARTHS. (Les foyers a combustion en suspension Stouff.) Translated from French. Institut Francais des 0Combustibles et de l'Energie I.F.C.E. p. 341-351, (1968).

A suspension-combustion hearth is discussed which was developed by M. O. Stouff and has been in operation for several years. Emphasis is placed on principles of design, operational procedures, performance results, and recent special applications (thin anthracite coal, and the drying of very damp combustibles).

13766

Graham, J. Ivon

THE ADSORPTION OR SOLUTION OF METHANE AND OTHER GASES IN COAL, CHARCOAL, AND OTHER MATERIALS. Colliery Guardian (London), 132(3168):809-811, Sept. 16, 1921. 7 refs.

The adsorption curve for coal dust and CO2, up to a 50% concentration, was first obtained by making several additions of known quantities of the gas and reading the equilibrium pressure. A definite amount of methane was then added and allowed to set for two days, to ensure equilibrium between the CO2 and methane in the gas mixture and that adsorbed by the coal. The points obtained for the adsorption of CO2 alone, and mixed with methane lay practically on the same curve when allowance was made for experimental error. There was, however, a marked effect on the adsorption of methane. A much smaller amount was adsorbed by the coal when CO2 was present than when only methane was present. It was found that when moisture was added to the coal dust, its adsorptive capacity decreased by 25%, and when 10.5% pyridine was added, the adsorptive capacity was reduced to a lower level. Crushing the coal in the laboratory did not produce an increase in the coal adsorption proportionate to the increase in surface area. It was concluded that the actual surface area of the particle forms only a small proportion of the total surface available for adsorption. Coal dust was examined for use in Army respirators during 1917-1918. It was found that while it was very effective for adsorbing chlorine gas, it was useless for the adsorption of carbon monoxide.

13834

Sprunk, George C. and H. J. O'Donnell

MINERAL MATTER IN COAL. Bur. Mines Tech. Paper 648. Bureau of Mines, Washington, D. C., 1942, 67p. 54 refs.

The occurrence and distribution of the most important microscopic forms of mineral matter in coal are described. The minerals were identified in thin sections of coal by means of the petrographic microscope. The most common minerals observed in the thin sections were kaolinite, oyrite, calcite, quartz, and siderite. Methods of identifying extraneous matter in the thin sections included immersion, microchemical, chemical, and x-ray methods. In addition to the major minerals, minor quantities of apatite, muscovite, zircon, epidote, biolite, augite, kyanite, rutile, staurotite, topaz, tourmaline, and chloritic material were present. Kaolinite was found in cleat joints, small cracks, fusain, resin rodlets, and attritus or ground mass of coal and in irregular impure masses imbedded within the coal. Iron pyrites occur in lenses and bands, balls or nodules, veins, pyritized fossils, and in finely disseminated particles. Calcite exists as veins in coal, particularly in the cleats and fractures. It is also found in fusain and in the ground mass of calcareous clay and shale partings. Siderite is present as nodules and as impure lenses and bands. Quartz is found in high-ash and bone coals. It is believed that the petrographic study of mineral matter in coal will have considerable practical value in planning an intelligent program of improving fuels by selective mining or coal cleaning.

14390

Delyagin, G. N.

ANALYSIS OF HEAT LOSSES FROM DISCHARGE GASES DURING THE COMBUSTION OF A WATER-COAL SUSPENSION. (Analiz poter' tepla s ukhodyashchimi gazami pri szhiganii vodougol'noy suspenzii). Text in Russian. Szhiganiye Vysokoobvodn., Topl. Vide Vodougol. Suspenzii, 1967:166-174. 11 refs.

Heat losses from the combustion products of five different coal types (three from Donbas and one each from the Kuznetsk and Podmoskov basins) in water suspension were analyzed, taking into account moisture, ash, and sulfur contents of the fuel, as well as the volume of water vapor and combustion products released. Analysis was made by reducing the dew point during the combustion of sulfurous mazuts and bituminous coal. Conducting the combustion of water-coal suspensions with a 1.05 air excess makes it possible to hold heat losses from the discharge gases at a level typical for modern boiler installations operating with dry pulverized fuel. Data for this analysis were taken from the literature.

14512

Ellis, Richard B.

FUSED SALTS. Chem. Eng. News, vol. 38:96-100, 102, 104, 106, Oct. 10, 1960.

The commercial importance of fused salts and research being done on them are reviewed. The most important use of fused salts is in making aluminum, magnesium, sodium, and less common metals. They are also aiding in the development of atomic power. Advantages over solid fuels include lower cost and continuous removal of undesirable fission products. An excess of reactive material is unnecessary, and nuclear radiation cannot structurally damage molten fluoride fuels. They also permit reactors to operate at lower pressures and higher temperatures and dissolve a higher percentage of materials that are either fertile or are already fissionable. Fused salts are used in the making of high purity uranium metal. Fused salt mixtures containing cryolite or other fluorides are being used as a flux to protect the surface of hot-dip aluminum coating baths. In baths for nitriding steels, fused salts can act as both flux and reagent and in descaling metals, they may be effective where ordinary acids fail. They are also effective as heat transferring agents and can closely control the temperature of reactive gases and vapors when these are bubbled through a fused salt bath. In many of their uses, the fused salts remain chemically inert, acting solely as a solvent or heat transfer medium. However, their use as chemical reagents is attracting more and more attention. What is especially needed is a better understanding of the fundamental processes involved in fused salt reactions. Conductivity, ionic mobility, transport numbers, and phase relationships have been studied. As knowledge of them grows, fused salts will contribute even more to chemical progress.

14686

Bockris, J. O'M.

AN INTRODUCTION TO FUEL CELLS AND ELECTROCATALYSIS. Franklin Inst. Research Labs., Philadelphia, Pa., Materials Science and Engineering Dept. and Public Health Service, Durham, N. C., National Air Pollution Control Administration, Proc. First Natl. Symp. on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968, p. 421-458.

Theoretically, natural gas conversion in an electrochemical engine (a combination of fuel cell and electric motor) should be twice that of the usual indirect method in which gas is burned and heat is used to produce steam and drive conventional generators. For many reactions of interest in the production of energy from chemical reactions (primarily hydrocarbon oxygen reactions), free energy is about 10% less than the enthalpy, and the maximum intrinsic effeciency of electrochemical engines is, therefore, 90%. Unfortunately, actual cell performance is limited by overpotential, whose sources are the delay in the reduction of oxygen and the oxidation of organic fuels in the fuel cell. Overpotentials, arising at the anode and the cathode, combine to give a potential loss in the cell. Because potential is proportional to exchange current density (a catalytic rate constant) and thus related to the catalytic power of the electrode, further development of fuel cells is contingent on the growth of the science of electrocatalysis. An unconventional catalyst must be found that permits oxidation and reduction reactions to take place with the highest exchange current densities and whose heat of activation is independent of the catalytic properties of its substrate. Since current density is dependent on substrate properties, the electrode reaction in a fuel cell cannot be associated with bonding between one of the reactants and the electrode. Porous gas diffusion electrodes and tungsten bronze catalysts may obviate present difficulties encountered with fuel cells.

14814

McCartney, J. T., H. J. O'Donnell, and Sabri Ergun

PYRITE SIZE DISTRIBUTION AND COAL-PYRITE PARTICLE ASSOCIATION IN STEAM COALS. CORRELATION WITH PYRITE REMOVAL BY FLOAT-SINK METHODS. Bureau of Mines, Washington, D. C., RI-7231, 18p., Feb. 1969. 18 refs. PB-183380

In an effort to correlate the size of pyrite particles in coal and coal-particle association with the removal of pyrite before burning, the Bureau of Mines conducted a study of 61 coals presently being used for electric power production. The results were obtained by visual microscopic studies of polished briquets of minus 14-mesh samples. Mean pyrite particle sizes ranged from 20 to 400 microns and proportions of pyrite contained in coal particles to an extent greater than 50% by volume (estimated) ranged from 20 to 95%. These parameters were correlated with reductions in pyrite accomplished by float-sink tests at 1.60 sp gr on 14-mesh, 3/8-inch, and 1.5-inch samples. The correlation coefficients between pyrite removal and mean pyrite particle size were 0.89, 0.84, and 0.79, respectively, for these samples. Correlation coefficients between pyrite removal and coal-pyrite association parameter were 0.92, 0.90, and 0.85, respectively. It is apparent that extent of pyrite removal can be fairly well predicted from microscopic analysis. (Author abstract modified)

14851

Vestal, Marvin L., Allan G. Day, III, J. S. Snyderman, Gordon J. Fergusson, F. W. Lampe, R. H. Essenhigh, and W. H. Johnson

KINETIC STUDIES ON THE PYROLYSIS, DESULFURIZATION, & GASIFICATION OF COALS WITH EMPHASIS ON THE NON-ISOTHERMAL KINETIC METHOD. Scientific Research Instruments Corp., Baltimore, Md., Contract PH 86-68-65, Rept. SRIC 68-13, 111p., Sept. 1968. 29 refs. CFSTI: PB 185 882

The theory of the non-isothermal technique developed by Juntgen and co-workers for the study of the kinetics of complex heterogeneous reactions was extended to include reactive flush gases and back reactions of the products, and was applied to experimental studies of pyrolysis, desulfurization, and gasification of coals in a series of 23 non-isothermal experiments. In addition, facilities were constructed for isothermal experiments and a series of 19 runs was conducted, utilizing both fast and slow heating rates to reach the isothermal operating temperature. The variables studied included coal particle size, flush-gas composition, gas flow rates, and the forms of sulfur in the coal. It was concluded that the non-isothermal method is a powerful technique for obtaining kinetic data necessary for the development of coal desulfurization processes. The back reaction of H2S with coke is the most important factor limiting the rate and efficiency of desulfurization. Practical desulfurization can possibly by accomplished during pyrolysis and without complete gasification by intimately mixing a suitable sulfur absorbent with the coal in the pyrolyzing reactor. It was also shown that the rate of the slowest desulfurization is sufficiently fast at 750 C and 1 atm of hydrogen that at least 99% desulfurization can be accomplished with a reaction time of 0.5 min. Below about 0.1 mm, the effect of particle size on the reaction kinetics appeared to be small. Heating rate effects were probably due to the fast back reaction. These conclusions indicated that desulfurization during coal gasification prior to combustion may be feasible and economically practical, provided a suitable sulfur absorbent can be found.

14876

Seguin, Richard L.

OPERATING DATA, DESIGN CRITERIA, RELIABILITY AND PRESENT CONDITION OF CHIMNEY LINERS AT VARIOUS CONSUMERS POWER COMPANY STEAM-ELECTRIC GENERATING STATIONS. Preprint 767, Am. Soc. Civil Engrs., New York, 33p., 1968. 9 refs. (Presented at the A.S.C.E. Annual and National Meeting on Structural Engineering, Pittsburgh, Pa., Sept. 30-Oct. 4, 1968.)

The operation and feasibility of various liners and coatings for chimneys of ten fossil-fueled electric power plants are reviewed. Performances of independent brick, corbel brick, and concrete liners are described under actual operating conditions. Included in the operating conditions are coal analyses, gas velocities, methods of firing, and unit loadings. Though some plants in the industry have found corbel brick liners unsatisfactory, no deterioration is reported for the liners when used in conjunction with fiber glass insulation and in chimneys having a maximum exit velocity of 60 fps. The linings resist corrosion when the sulfur and ash content of the coal used do not exceed 2 1/2% and 11%, respectively. Independent concrete liners with no protective coating also perform well under the above conditions. Periodic inspections reveal no penetration or deterioration of the concrete. Use of these liners has resulted in substantial cost savings. Independent brick liners coated with Stockfas are holding up well in chimneys with maximum velocities of 90 fps. Corrosion of the concrete floors of these chimneys is now prevented by cleaning devices for washing off fly ash. None of the chimneys discussed, some dating back to 1937, have required major repair work. However, stainless steel caps, which deteriorated rapidly, have been replaced by cast iron caps. The degree to which the chimney liners can resist the highly corrosive unit train coal now being used is not known.

15714

Ramsden, A. R.

APPLICATION OF ELECTRON MICROSCOPY TO THE STUDY OF PULVERIZED-COAL COMBUSTION AND FLY-ASH FORMATION. J. Inst. Fuel, 41(335):451-454 Dec. 1968. 7 refs.

A brief description is given of a probe and sampling technique for collecting particles from the gas stream of a pulverized-coal-fired test rig for direct examination by transmission electron microscopy. The technique is of value in studying the combustion of pulverized-coal particles and the formation of fly-ash. Initial experimental observations, made during combustion of some New South Wales bituminous coals, are presented. (Author's Abstract)

16210

Institute of Gas Technology, Chicago, Ill.

LNG: A SULFUR-FREE FUEL FOR POWER GENERATION. Contract PH 22-68-58, Final Report, Proj. 8926, 560p., May 1969. 450 refs. CFSTI PB 184353

The availability of natural gas for conversion to liquified natural gas (LNG) and subsequent transport to the U.S. East or West Coast was assessed. Transport costs to the point of use and the cost of electric power with LNG used as power plant fuel were estimated. Price and availability of gas at a remote source was based on current information about reserves, indigenous requirements, and marketing plans of the agencies controlling gas at the source. Combustion of natural gas is easily controlled, and the fuel is easily metered and handled, an important factor in keeping plant costs low. When compared to the cost of electricity generated by competitive fuels, LNG could possibly be a lower cost fuel. Natural gas use and availability are discussed for the U.S. and the world. The long-term viability of the U.S. natural-gas producing industry depends on the quantity of natural gas reserves ultimately available. The remaining recoverable reserves were estimated to be 976-1645 trillion CF of gas. Areas of the world which, because of their reserves, availability of gas for export, and proximity to the U.S., are potential sources of imported gas are Algeria, Libya, Nigeria, Venezuela, Colombia, Trinidad, Alaska, and Canada. The economic feasibility of LNG for electric power production is demonstrated: natural gas is the most economical fuel available for electric power production. The feasibility of using LNG as a sulfur-free fuel for power generation will depend on delivery costs, which varied considerably with the alternatives evaluated. Noneconomic factors affecting the feasibility of LNG for electric power production are also discussed. Regulatory and political factors are considered.

16376

Arai, Yasuo, Hiroshi Takenouchi, and Shoichiro Nagai

REACTIONS BETWEEN CAO AND SO2: ABSORPTION MECHANISM OF SO2 INTO QUICK LIME (I). (CaO to SO2 to no hanno shosekkai no SO2 kyushu kiko (dai 1 ho)). Text in Japanese. Sekko to Sekkai (Gypsum Lime), no. 44:5-11, 1960. 14 refs.

Equilibrium in the system CaO-SO2 was investigated at various temperatures to determine the absorption mechanism of sulfur dioxide gas in quick lime. Pure sulfur dioxide gas was introduced into a heat tube containing calcium dioxide (sic) powder; velocity of the gas was maintained at 200 cc/min. The reaction products between the solid and gas phases were investigated by chemical analysis and X-ray power diffraction. Absorption velocities of SO2 in quick lime prepared from limestone calcined at various temperatures were measured.

Results showed that the amount of combustible sulfur varies according to the coal used. Sulfur is easily oxidized to sulfur dioxide and volatilized with other combustion gases by firing coal at 600 to 800 C under leading of air. Reactions between CaO and SO2 are minimal below 400 C, but calcium sulfite is produced by the reaction: CaO + SO2 yields CaSO3, above 400 C. With rising temperatures, the amount of calcium sulfate formed by decomposition of calcium sulfite increases according to the reaction: 4CaSO3 yields 3CaSO4 + CaS. Above 800 C, the equilibrium between calcium oxide and calcium sulfate is such that both sulfite and sulfide are converted to sulfate by contact with air. The semi-stable zone of sulfite and sulfide can extend from 400 to 800 C. Beyond 1000 C, calcium oxide loses its ability to absorb sulfur dioxide as the process of decomposition progresses. (Author abstract modified)

16589

Hileman, A. R., J. P. McKinnon, and J. K. Dillard

STATION AND LINE INSULATION DESIGN 1100-KV. Preprint, 10p., 1968. 14 refs. (Presented at the Conference Internationale des Grands Reseaux Electriques, 22nd Paris, June 10-20, 1968, Paper CR 25- 06.)

Switching surge and impulse tests were performed to permit design of a 1100-kV station to supply an underground transmission test facility. Using a 1.6 p.u. switching surge design criteria, the support tower for the high-level bus has a 7.45 minimum strike distance with a O-unit post insulator, 7.5 m in length, hung from the truss. Nine post insulators will be used in the station lower bus. Switching surge test results provided data to assess the design of 1100 kV systems. The comparison of the lightning, contamination, and switching surge requirements showed that it appeared technically unfeasible with present available knowledge and materials to design a 100 kV transmission line to withstand greater than 1.8 p.u. switching surges. Switching surge withstand design levels of 1.6 p.u. are feasible. Although it is technically possible to meet the estimated contamination requirements, the design may be uneconomical in regions of high pollution. Estimates of insulation requirements in 1100 kV stations show that it is technically unfeasible to design switching surge levels greater than 1.6 p.u. using present design philosophy. Contamination may be a greater problem in stations than for transmission lines. Research is immediately required on the breakdown mechanism of large-spaced gaps, methods of reducing the surge applied to a system, and contamination. (Auther summary modified)

16883

Halstead, W. D. and E. Raask

THE BEHAVIOUR OF SULPHUR AND CHLORINE COMPOUNDS IN PULVERIZED-COAL- FIRED BOILERS. J. Inst. Fuel, 42(344):344-349, Sept. 1969. 14 refs.

Laboratory experiments and probe tests in boilers have been made to study the decomposition of pyrite, the evaporation of sodium chloride and the formation of sulfates in the flue gas of pulverized-coal-fired boilers. The results have been compared with theoretical predictions made on the basis of thermodynamic calculations. In large boilers where there is good mixing of the fuel and combustion air it is shown that the conversion of chloride to sulfate is complete when the flue gas leaves with only trace amounts of chloride. Initial deposits on the furnace tubes will contain significant amounts of chloride and pyrite residues when there is either a localized deficiency in oxygen, or a particularly short residence time of sulfur and chlorine compounds in the flame. (Author's Abstract)

17592

Abernethy, R. F., M. J. Peterson, and F. H. Gibson

SPECTROCHEMICAL ANALYSES OF COAL ASH FOR TRACE ELEMENTS. Bureau of Mines, Washington, D. C., RI 7281, 30p., July 1969.

Spectrochemical analyses were made of ash from 827 U. S. commercial coals for barium, beryllium, boron, chromium, cobalt, copper, gallium, germanium, lanthanum, lead, lithium, manganese, molybdenum, nickel, scandium, strontium, tin, vanadium, ytterbium, yttrium, zinc, and zirconium. These 22 elements were detected in almost all of the ash samples examined. In addition, arsenic, bismuth, cerium, neodymium, niobium (columbium), rubidium, and thallium were detected in many samples. Arsenic, with a limit of detection of 0.005% in ash, was found in 67% of the samples from the Eastern states, 41% of those from the interior states, and 16% of the Western state ashes. Rubidium, with a limit of detection 0.001%, was found in all samples from the interior states, but in only 58% of the samples from the Western states. All state averages for manganese content in ash are less than the crustal abundance. The average content of copper, nickel, and rubidium in ash of the Western state coals usually is less than the crustal abundance for each element. However, most of the ashes from the Eastern and interior states are enriched in these elements. Averages for the other elements generally show some enrichment in the ash. (Author summary modified)

17594

Okaniwa, 0Keiji and Jintaro Suzuki

FLUIDIZED COMBUSTION OF SOLID FUELS. (Funkyu ryudo nensho). Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), vol. 38:429-437, 1959. 7 refs. Translated from Japanese. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 17p., May 16, 1969.

Various solid fuel combustion experiments were conducted on commercial scale experimental combustion equipment for the purpose of application of low grade fuels. Hokusyo coal and other fuels were chosen for sample fuels. The development of new combustion mechanisms by aerodynamical and thermodynamical principles of fluidized reactions were explored. The method is very useful as a combustion process for burning the high ash contents and the low generation of heat (about 2500 kcal/kg) of low grade coal. Even the hard coal and the stone abandoned in coal selection can be used as the fuel. Fairly crude coal can be used; thus, it is possible to adjust the micro-coal machine to a small size and to decrease the installation, operation, and maintenance costs. The micro particle combustion section in the upper part of the combustion chamber and the fluidized combustion in the lower part proceeds concomitantly, makes the combustion stable, and enables the control of change of loss of heat. With this method, large amounts of micro particles produced at the coal selection may be used without passing the micro coal machine. Good results were obtained for several experiments. (Author conclusions modified)

18170

Davies, D. T.

COAL PYRITES. J. Inst. Fuel (London), 21(331):301-311, 331, Aug. 1948. (Presented at the North-Eastern Sect. Meeting, Inst. Fuel, Newcastle-on-Tyne, Feb. 2, 1948.)

A review is presented of wartime development of sulfur recovery from coal in the United Kingdom. The necessity of using coal pyrite was due to the limited amount of sulfur imported during World War II. A total of 115,000 tons of sulfur were recovered by eight operating plants in addition to more than 140,000 tons of coal which would normally have been discarded. The pyrites recovered contained 40 to 42% sulfur and provided only 5% of the sulfuric acid trade's requirement. The pyrite removal methods of all the operating plants are described. All plants utilized a crushing technique which involved pulverization of the coal and separation of the pyrite by specific gravity and screening. Pyrite recovery averaged 60 to 75%. The 1939 installation costs were recovered by 1946, and seven of the original eight plants are still in operation in 1948.

18185

Jordan, C. W., A. L. Ward, and W. H. Fulweiler

GUM DEPOSITS IN GAS DISTRIBUTION SYSTEMS. Ind. Eng. Chem., 27(10):1180-1190, Oct. 1935. 31 refs.

The efficacy of iron sulfide for the absorption of nitric oxide, together with conditions favoring its use, was determined by a series of experiments involving the absorption of undiluted and dilute nitric oxide by iron sulfide, and alkaline and metallic sulfite absorbents. The highest activity for the absorption was obtained by sulfided Lux iron oxide to which sufficient sodium bicarbonate had been added to give an alkali ratio of 50%. Iron sulfide is economically feasible as an agent for the commercial purification of manufactured gases because it can be made from the hydrogen sulfide already present in commerical gas, and it is not poisoned by sulfur of cyanogen compounds, reduced by hydrogen, or affected by carbon dioxide or carbon monoxide. Though it does react with the small amount of oxygen present in manufactured gas, iron sulfide can be used to advantage in removing hydrogen sulfide from gas. As a result of the laboratory experiments, an inexpensive, commercial process was developed for removing all of the nitric oxide.

22319

Luther, H., G. Bergmann, H. D. Engelmann, and J. Zajontz

EXPERIMENTS FOR THE DETERMINATION OF REACTION KINETIC MAGNITUDE FOR THE ISOTHERMO PYROLYSIS OF BITUMINOUS COAL. PART II. DEVELOPMENT OF AN ANALOG COMPUTER PROGRAM AND COMPARISON OF RESULTS OBTAINED UNDER VARIOUS CONDITIONS. (Verscuche zur Bestimmung reaktionskinetischer Grossen bei der isothermen Steinkohlen-Pyrolyse). Chem. Ing. Tech., 41(3):743-790, July 1969. 7 refs. Translated from German. Belov and Associates, Denver, Colo., 22p., May 24, 1970.

An analog computer program was developed to determine first-order reaction kinetics involved in the isotherm pyrolysis of coal. The calculated constants of reaction speed can be assigned to reaction phases independent of the degree of carbonization. Activation energies of 48-66 kcal/mol and thrust factors of 10 to the 13th power to 10 to the 17th power reciprocal min were determined for methane, propane, ethylene, and carbon monoxide generated by the pyrolysis of bituminous coal. For ethane, these values lie between 50-90 kcal/mol and 10 to the 14th power to 10 to the 25th power reciprocal min. In a second analog computer program, kinetic reaction data obtained in the first program were used to establish degasing curves to be expected for a given speed of heating up under nonisothermal conditions. (Author introduction modified)

22587

Luther, H., G. Bergmann, and T. N. Sreenivasan

EXPERIMENTS FOR THE DETERMINATION OF REACTION KINETIC MAGNITUDE FOR THE ISOTHERMAL PYROLYSIS OF BITUMINOUS COAL. (Versuche zur Bestimmung reaktionskinetischer Grossen bei der isothermen Steinkohlen-Pyrolysis). Chem. Fabrik, 40(7):317-364, April 10, 1968. 11 refs. Translated from German. Belov and Associates, Denver, Colo., 26p., May 22, 1970.

Formation of methane, ethane and hydrogen were observed volumetrically and by means of gas chromatography during isothermal pyrolyses of bituminous coal, vitrinite and exinite in a vacuum between 400 and 500 C. The constants of speed of reaction, activation energies (40 to 65 kcal/mol) and perturbation factors of the individual reaction stages were calculated from the values measured according to the method of the least square deviations. The gas formation curves which were measured non-isothermally were analyzed with the kinetic values found. A comparison with kinetic data found by various experimental methods showed essentially good agreement. While the formation curves for the total amount of gas, methane and hydrogen were quite similar to each other, the curve for the formation of ethane deviated noticeably. Values for methane and hydrogen which are approximately equal indicate that the formation of these gases takes place according to the same reaction mechanism, but the mechanism for ethane formation is yet to be investigated. The appendix describes the fitting of a curve on data points by linear or non-linear regression and iterative calculation by the method of steepest descent.

24272

Akazaki, M. and M. Hara

EFFECT OF AEROSOLS ON IMPULSE BREAKDOWN VOLTAGE. Elec. Eng. Japan, 89(10):57-65, 1969. 15 refs.

As a result of the increasing demand for electric power, construction of EHV transmission lines is increasing. In designing these lines, the flashover characteristics of the system vs. impulse voltage and switching surge have attracted world-wide attention. In the operation of substations and transmission lines, cases often occur where not only rain drops but particles are floating in the air gap. Because of this, the discharge mechanism of the sphere-to-plate gap was studied in the presence of water drops and conductive or dielectric particles. Also investigated were the discharge characteristics of needle-to-plate, rod-to-plate and sphere-to-plate gaps in the presence of particles. In addition calculations were made on the field intensity of the air gap of a sphere-to-plate electrode where particles were floating. The results show that electrical resistance decreases when particles are present in the air gap; the decrease is marked whether or not the particles are floating. The flashover characteristic is explained by the development of corona streamers and leaders in the presence of an aerosol. By shortening the gap between the particle and the sphere electrode, the leaders cause nonuniform fields.

G. EFFECTS-HUMAN HEALTH

00981

A.E. Martin

EFFECTS OF POWER STATION EMISSIONS ON HEALTH. World Health Organization, Geneva, Switzerland, (WHO/AP/66.27.) 1966. 43 pp.

Prevailing levels of atmospheric pollution in St. Helens, Warrington and Widnes are high and the available evidence indicates that the incidence and mortality from bronchitis is also high. Atmospheric pollution is known to be an important contribuyinh factor influencing both the number of cases and of deaths from this disease. Any proposal which might contribute towards an increased level of air pollution in the district must therefore be examined with great care. From the height at which the fumes from the proposed power station would be discharged and from the known behaviour of chimney emissions under varying weather conditions the evidence indicates that the power station would make but a timy contribution to the prevailing ground level concentration of SO2. Moreover the sulfur dioxide pollution from the power station would be of a transient nature and woudl only affect the surrounding area at times when the natural ventilation is good and ground pollution from local sources is low. At times, when owing to climatic conditions pollution from local sources is high, fumes from the power station would not descend to ground level within this area. For the reasons given in this report and subject to the acceptance in the main report of the findings on the evidence on chimnev emissions, it is the author's opinion that the pollution from the proposed power station would not add any appreciable hazard to the health of the surrounding population.

01340

M. Conveneovole, J. Carpentier, and U. Vidali

WORK OF THE EUROPEAN COAL AND STEEL COMMUNITY IN CONNECTION WITH PREVENTION OF OCCUPATIONAL HAZARDS. Am. Ind. Hyg. Assoc. J., Vol. 26: 619-623, Dec. 1965.

The aims of the European Coal and Steel Community are outlined with regard to the improvement of living and working conditions for workers in the mining and iron and steel industries of the six Community countries. The valuable interchange of information and experience conducted between industry and researchers in the health and safety field is described. Research grants provided since 1955 have partly financed nearly 500 projects, carried out at 120 research centers, the total amount furnished for this purpose being $8,000,000. The still more ambitious projects now in progress, launched with the aid of a 5-year appropriation of $15,000,000 relate to such matters as occupational diseases, human factors affecting safety, industrial ergonomics, and dust prevention. (Author abstract)

01865

J.H. Ludwig P.W. Spaite

CONTROL OF SULFUR OXIDES POLLUTION: THE CHALLENGE TO THE CHEMICAL ENGINEER. Chem. Eng. Progr. 63, (6) 82-6, June 1967. (Presented at the American Institute of Chemical Engineers, Detroit, Mich., Dec. 4-8, 1966.)

This presentation deals with the major unmet need in air pollution control of today, and with the need to develop economical and practical methods for the control of gaseous pollutants, especially vehicle exhaust and sulfur situations will have to be handled within a framework of severe economic restrictions. The author points to the period 1975-1980 in which the generation of thermal power from fossi fuels will be in strong competition with nuclear power and will be hard pressed to retain their competitive position unless economic menas for eliminating pollution can be found. The development of new systems for conversion of fossil fuels to electricity which integrate sulfur removal into the power cycle should begin now.

02417

A.E. Martin

REPORT ON CHIMNEY EMISSIONS (RATCLIFFE-ON SOAR POWER STATION). Central Electricity Generating Board, England.

Document is the official report on air pollution by the Medical Assessor, following the Minister of Power's public inquiry into the proposal by the Central Electricity Generating Board to build a 2,000 MW coal-fired power station at Ratcliffe-on-Soar, near Nottingham. After consideration of the existing knowledge of the medical effects of atmospheric pollutants, and of the concentrations of pollutants which would reach ground level from the proposed power station at Ratcliffe-on-Soar and be superimposed on the existing levels of atmospheric pollution in the area, the opinion that the power station emissions would not add any appreciable hazard to the health of the surrounding population is presented.

04136

S. Tanaka, Y. Naruo, and T. Toyofuku

SILICOSIS AND SILICOTUBERCULOSIS IN A COAL MINE. Japan. J. Ind. Health (Tokyo) 2, (8) 12-8, Aug. 1960.

If silicosis is graded as S0, S1, S2, S3, and S4 with increasing severity, grade S0-1 can be given to miners employed over 3 yr below ground and S1 and above can be assigned to those employed over 5 yr underground; the most silicotic miners are found among those employed 7-9 yr underground. These results were found in a study of the course of illness of 909 miners with silicosis and 143 silicotic miners covered by the Workmen's Compensation Law from 1952-1959. According to X-ray examination of workers employed for 5-6 yr the aggravated cases are found to be 7.1% in SO-1, 22.5% in S2, and 88.2% in S3. Among these aggravated cases infiltration images are found in 97.6%. Unusually large nodulation, which has great significance in the aggravation of silicosis, is found in 21.1% of S1 cases and 73.5% of S2 cases. The development of this nodulation is found among all coal workers, except for the low incidence among coal collectors. Aggravated cases are found in coal-face workers, direct workers, indirect workers, and coal collectors, in decreasing order. Cases of infiltration are mostly of a tubercular nature, and some of them are due to the conglomeration of silicotic nodules. (Author summary modified)

06806

H. J. Einbrodt

EXPERIMENTS ON THE ELIMINATION OF DUST FROM HUMAN LUNGS. Ann. Occupational Hyg. (London) 10 (1), 47-9 (Jan. 1967).

The dust content of the individual lung lobes of two groups of miners was determined with formamide. The first group consisted of lungs from victims of a mine disaster; the second included lungs of retired miners who were not exposed to heavy dust loads for at least 10 years prior to their death. In comparison, the latter group exhibited less dust content, implying a self-cleansing over the period of no dust exposure. (Author summary)

06826

P. J. Lawther

SOME ANALYTICAL AND CLINICAL ASPECTS OF BRITISH URBAN AIR POLLUTION. Proc. Symp. Atmospheric Chemistry of Chlorine and Sulfur Compounds, Cincinnati, Ohio, 1957. (Geophysical Monograph No. 3.) (1959). pp. 88-96.

Variation of concentration of smoke, SO2 concentration, temperature and humidity in the air of the city of London during a period of acute pollution in January 1956 is given. Fog formation is compared with the occurrence of chronic bronchitis, as well as some clinical aspects of air pollution in London.

07039

J. M. Rogan, S. Rae, W. H. Walton

THE NATIONAL COAL BOARD'S PNEUMOCONIOSIS FIELD RESEARCH - AN INTERIM REVIEW. Proc. Intern. Symp. Inhaled Particles Vapours, II, Cambridge, England, 1965. Pp. 493-508, 1968.

The history of the research is traced, and data on dust concentrations, pneumoconiosis prevalence and progression between the first and second medical surveys are presented. The historical background, the original plan of the pneumoconiosis field research, the research up to the end of the second medical surveys (1953-1963), other developments affecting the research, the third survey period (1964) and the research in retrospect and prospect are discussed.

07138

Yanysheva, N. Ya.

THE EFFECT OF ATMOSPHERIC AIR POLLUTION BY DISCHARGES FROM ELECTRIC POWER PLANTS AND CHEMICAL COMBINES ON THE HEALTH OF NEARBY INHABITANTS. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 1:98-104, Jan. 1960. (Also published in Gigiena i Sanit., (8):15-20, 1957.) Translated from Russian. CFSTI: TT 60-21049

A study was made of the effect of industrial discharges on the health of inhabitants of a large industrial center the atmospheric air of which was being polluted by the discharges of several production and manufacturing plants. A study was made of the degree of atmospheric air pollution with dust (fly ash), SO2, sulfuric acid aerosol, hydrogen sulfide, chlorine, nitrogen oxides, and phenol. Air samples were collected by the aspiration method under the smoke plume coming from smoke stacks at distances ranging from 200 to 2,500 meters from a chemical combine and an electric power plant, and up to 800 meters from a phenol producing plant. The morbidity rate in two villages in the industrial area and one village in a control area was studied. Pollution of the atmospheric air with dust (fly ash), sulfurous gas, hydrogen sulfide in concentrations many times above the allowable limits and of aerosols of sulfuric acid and chlorine in concentrations just above the allowable limits, as well as the oxides of nitrogen and phenol within the limits of allowable concentrations deleteriously affected the population's health. It was concluded that the above mentioned pollutants produced the following pathologic results: a) Increased by several times the frequency of occurrence among children and adults of diseases of the respiratory organs, of the nervous system, of the organs of vision and of the skin. b) Lowered the resistance of the population to such infectious disease as the grippe and angina. c) Induced in children a state of susceptibility to the development of rickets and anemia, and brought about early manifestations of diffuse pneumosclerosis in isolated cases.

08230

DISCUSSION ON AIR POLLUTION. Practitioner, Vol. 192, p. 563-566, April 1964.

A study of the effects of air pollution on respiratory disease in London and Sheffield, England, is presented. After a pilot study the previous winter, it was decided to use a daily record sheet for each participating doctor, and hope that he would always have it with him so that each consultation, both formal and informal, planned and unplanned, could be included in he study. The analysis was carried out by the College of General Practitioners0 Records and Statistical Unit in Birmingham. Included in the report are: the pattern of respiratory illness in the two cities; the detection of air pollution; a brief discussion of the National Survey methods for particulate and SO2; and the possible role of the spores of common molds in respiratory disease.

08232

SULPHUR DIOXIDE IN THE AIR. Brit. Med. J., No. 5432, p. 339-400, Feb. 13, 1965.

One of the main contaminants of the atmosphere in Great Britain is sulphur dioxide. It is released whenever carbonacesous fuels con taining sulphur, such as coal, coke, and oil, are burnt, and it has irritant and corrosive properties. Concentrations of sulphur dioxide in the city of London have averaged 0.11 p.p.m. in the summer and 0.17 p.p.m. in winter. The highest recorded concentration of sulphur dioxide in the London smog of 1962 was 1.98 p.p.m. measured over one hour. Since the introduction of the Clean Air Act in 1956 the concentration of smoke in smoke-control areas has fallen apprciably, but the concentration of sulphur dioxide has not followed suit because the technical difficulties are such that is has been considered impractible to impose restrictions on its emission. At present there is no single way of removing sulphur dioxide, but much can and should be done to keep the concentration of this corrosive and possibly harmful gas in the atmosphere as low as possible.

11300

Davis, Kieffer

SIGNIFICANCE OF SULFUR STUDIES ON ENVIRONMENTAL HEALTH. Proc. Am. Petrol. Inst., Vol. 48, pp. 591-610, 1968. 8 refs. (Presented at the 33rd Midyear Meeting of the American Petroleum Institute's Division of Refining, Air and Water Conservation, Philadelphia, Pa., May 16, 1968, Preprint 30-68.)

Four research program dealing with health impairment due to sulfur compounds in the air are briefly described. One study is designed to determine the effects of the inhalation of different dusts on animals with papain induced (artificial) emphysema. A second project will study the effects of inhalation of SO2 and particulates on a series of animals under controlled conditions. The third study will concentrate on the synergistic effects of pollutants. The fourth project is compiling data on the health of a large group of individuals in Chicago suffering from bronchopulmonary disease.

11339

W. Winkelstein, Jr.

STOMACH CANCER: POSITIVE ASSOCIATION WITH SUSPENDED PARTICULATE AIR POLLUTION. State Univ. of New York, Buffalo, Dept of Preventive Medicine, 13p., 1968. 11 refs. (Presented at the Air Pollution Medical Research Conference, Denver, Colo., July 22-24, 1968, Session II: Epidemiologic Relationships, Paper 10.)

Mortality rates for gastric cancer in white men and women, 50-69 years of age, are almost twice as high in areas of high suspended particulate air pollution as in areas of low pollution in a northeastern United States industrial area. This association appears to be independent of the effect of economic status and is not apparently attributable to the ethnic distribution of the population in the study area. (Author's summary)

11437T

Tsvetkov, V. P., B. A. Tsybalyskiy, and A. P. Sapozhnikov

INFLUENCE OF DUST ON WORKERS AT THE KASHIRSKIY STATE ELECTRIC POWER STATION. Translated from Russian. Klinich. Med. 11(9-10):458-465, 1933. 8 refs.

The effect of lignite coal dust and ash in the Kashirskiy Electric Power Plant near Moscow on the health of exposed workers was studied. A total of 148 workers was examined. While dust pollution of lungs can occur after only 5 years of work in a power plant, the development of actual pneumoconiosis is considered to require exposure of at least 20 years. It was found thar carbon dust and ash from litnite coal originating in the vicinity of Moscow penetrate the pulmonary tissue to cause reactive changes characterizing pneumoconiosis. Clinical details on various subgroups of the workers, including X-ray findings, are mentioned. The harmful component in both the coal and ash dusts is silica which is present in large amounts. The presence of sulfur anhydride in household dust requires further study. Based on the dust particle concentration, the pollution even in the most hazardous areas of the electric plant is considered moderate. Only 4 cases of pneumoconiosis were found after 10 years of service. Future studies on the effect of dust on children are indicated, on the basis of inconclusive findings on 19 children living in the area.

11828

D. R. Lamb, R. D. Shriner

PROCEEDINGS OF THE ROCKY MOUNTAIN REGIONAL CONFERENCE ON AIR POLLUTION (NOVEMBER 15-17, 1967.) Wyoming Univ., Laramie, Coll. of Commerce and Industry,110p.,1967. ((140)) refs.

The purpose of the Conference was to bring together representatives of government, industry, and research for a meaningful discussion of air pollution and its causes, effects, and cures. The following topics were discussed: Industrial Gases, Particulates, Industrial Solid Waste Management, The Internal Combustion Engine and Smog, Banquet Session, Air Pollution Effects on Meteorology and Visibility, Air Pollution Effects on Humans, Air Pollution Effects on Animals, Air Pollution Effects Plants, Air Pollution Effects on Materials, Economics of Air Pollution, Air Pollution Control by Feed Lots, Air Pollution Control by Petroleum Plants, Air Pollution Control by Power Plants, Air Pollution Control by Wood Products Plants, and Air Pollution Control by Mineral Processing Plants.

12289

Perelatov, V. D., A. I. Bespalov, A. D. Stepanova, and L. S. Potapenko

EFFECT OF DISCHARGES FROM THE SHAKHTY DISTRICT POWER PLANT ON THE POPULATION'S HEALTH. (Vliyanie vybrosov Shakhtinskoi GRES na zdorov'e naseleniya). Hyg. Sanit., 33(7-9):100-102, July-Sept. 1968.

An air quality survey in the town of Shakhty showed systematic and heavy air pollution within a radius of up to 2 km consisting of dust, sulfur dioxide, and carbon monoxide from a power plant close to the residential areas. Medical examination of schoolchildren living in the power plant area showed a prevalence of catarrhal charges in the nasopharynx 1.9 times higher than in a control group; that of bronchitis, 2.9 times higher; and that of dust in the eyes, 2.5 times higher. A sanitary-protective zone greater than 500 m is considered necessary for a plant of this capacity; at present, there is no zone at all; on one side, the plant stacks are only 150 m from residences. It is recommended that the plant be rebuilt with adequate chimney heights and efficient ash-collection facilities.

14530

Fritze, E., F. Gundel, E. Ludwig, G. Mueller, H. O. Mueller, and B. Petersen

THE HEALTH SITUATION OF MINERS OF A COAL MINE. (Die gesundheitliche Situation von Bergarbeitern einer Kohlenzeche). Text in German. Deut. Med. Wochschr., 94(8):362-367, Feb. 21, 1969. 37 refs.

The tuberculin sensitivity and the radiologically-determined condition of the lungs of 1700 'healthy' coal miners were analyzed for different age groups. Categories of miners with and without pneumoconiotic lung modifications were compared with a group not exposed to dust and a group of retired miners with severe pneumoconiosis, and the occurrence of rheuma factors and serum-complement titers was determined. The analysis yielded an above-average incidence of tuberculosis even in the youngest group of miners, a frequency of identification of rheuma factors in 13.3% of the miners (or 16%, if the group with severe silicosis is included), as well as lowered complement titers compared with a non-mining group. The frequency of occurrence of the rheuma factors and the lowering of the complement titer does not correlate with the presence of pneumoconiotic changes of the lungs but is likely to be connected with the dust loading.

16192

Gusev, M. I. and K. I. Akulov

COMPLEX HYGIENIC EVALUATION OF AIR POLLUTION IN CITIES OF THE RSFSR. (Kompleksnaya gigiyenicheskaya otsenka atmosfernykh zagryazneniy v gorodakh RSFSR). Text in Russian. In: Sanitation Measures Against Air and Water Pollution in the Planning of Cities (Ozdorovleniye vozdushnogo i vodnogo basseynov gorodov). Government Committee on Civil Building and Architecture (ed.), Lecture series no. 2 Kiev, Budivel'nik, 1968, p. 7-11. 4 refs.

A total of 106 million rubles was spent from 1958-1966 to set up 7827 gas collecting installations and 138 laboratories to deal with air pollution in the Russian Soviet Federated Socialist

Republic. Studies of emissions from State Regional Electric Power Stations with chimneys 120-180 meters tall showed that maximum permissible concentrations of pollutants were not exceeded beyond distances of 15 km. Adverse effects on elementary school children within these areas have been verified. Work is being done by the Erisman Hygiene Research Institute in Moscow to establish the nature and degree of pollution from a number of industrial chemical sources and their effects on residents living nearby. Work done in 1965 at the Ufimovskiy Labor Hygiene and Professional Illness Research Institute is reviewed. Studies of the ferrous metallurgy industry done by the Erisman Institute are also noted. Joint planning by the Erisman Institute and the Central City-Planning Institute for multiple dwellings in Moscow and Volgograd examined the problem of motor vehicle exhaust.

16837

Speizer, Frank E.

AN EPIDEMIOLOGICAL APPRAISAL OF THE EFFECTS OF AMBIENT AIR ON HEALTH: PARTICULATES AND OXIDES OF SULFUR. J. Air Pollution Control Assoc., 19(9):647-656, Sept. 1969. 45 refs.

This review evaluates the present state of our knowledge of the effect on human health of environmental exposure to oxides of sulfur, sulfates, and particulate matter. The measurements of these pollutants in ambient air are the net results from all sources of pollution in combination with factors influenced by weather and meteorological considerations and cannot therefore incriminate single source, or a single pollutant. Direct effects from acute, high ambient air pollution disasters have been adequately demonstrated. Specific working groups exposed to unusually high levels of these pollutants do not demonstrate dramatic effects. However, the association between the prevalence of chronic respiratory disease in the general population and specific levels of these air pollutants have been demonstrated. The major thrusts of epidemiological investigations have been to study the effects of chronic exposure to ambient levels of smoke and sulfur dioxide. The studies to date have collected and analyzed point-prevalence data and information obtained from retrospective investigations. Although epidemiological investigations cannot prove a cause-and-effect relationship, the consistency of the results is such that one must conclude that a causal association is likely. A discussion by I. J. Selikoff is presented in the appendix. (Author's Abstract Modified)

18109

Cassell, Eric J.

THE HEALTH EFFECTS OF AIR POLLUTION AND THEIR IMPLICATIONS FOR CONTROL. Law and Contemporary Problems, 33(2):197-216, Spring 1968. 49 refs.

A brief review of the health effects of air pollution has been presented. The nature of the biological problem itself and evidence of various lines of inquiry indicate that while many of the pollutants in urban atmospheres have demonstrable effects on health, the effects of air pollution as a whole are not explained by the individual constituents acting separately. Because of the multifactorial nature of air pollution and its effects, control based primarily on standards for individual pollutants may be inadequate to the problem. The proliferation of pollutant and manufacturing or other process changes makes fixed standards seem as inappropriate to the sources of pollution as they are to the health effects. Evidence is presented for a return to more broadly based control concepts. The need for re-examination of control concepts is enhanced by the fact that air pollution is a protype problem, typical of the complex interrelationships of public health problems in a modern industrial urban society. (Author's Summary)

20700

Lindall, Arnold W.

EFFECT OF AIR POLLUTION FROM FOSSIL FUEL COMBUSTION ON HUMAN HEALTH. Minn. Med., 53(3):321-326, March 1970. 24 refs.

The effects of air pollution on human health are discussed. A significant correlation was found between local deaths due to bronchitis in England and the pH of rain in an area that was in a direct wind line from the industrial centers. In another study, pneumonia mortality correlated strongly with atmosphere sulfate deposition. In an epidemiological study, sulfur dioxide was consistently correlated with relevant disease. When the disease rate for various categories was analyzed for days of the low 1/3 of SO2 concentration and for days of the high 1/3 SO2 concentration, infectious disease, acute respiratory infection, and bronchitis showed the greatest increase on high SO2 days. In another study, lower respiratory infections in children were related to air pollution, while upper respiratory diseases were not. Cigarette smoking causes a primary effect on the bronchioles, leading to impaired defense against infection. With continued exposure, panhobular emphysema ultimately results. National studies are recommended to place the morbidity rate from pollution in quantitative terms so that the relative pollution dangers can be assessed. Some of the elements of pollution include the following: carbon dioxide, of little immediate health significance; carbon monoxide, reaching high levels in traffic; nitric oxide and nitrogen dioxide, both found in urban air of which NO2 is highly toxic; peroxyacetyl nitrate; and ozone, which causes changes in lungs at low concentrations.

21276

Ayres, Stephen M. and Meta E. Buehler

THE EFFECTS OF URBAN AIR POLLUTION ON HEALTH. Clin. Pharmocal. Therap., 11(3):337-371, 1970. 108 refs.

The relationship between pollutant emissions, atmospheric cleansing processes, and ambient air pollution is described. A high pollution potential is often produced in late fall and early winter by an anticyclone, associated with fair weather, low wind speeds, and temperature inversions. Toxicological studies involving the administration of sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate emissions to animals and man are reviewed. They demonstrate that single pollutants cannot explain the irritant potential of the urban atmosphere. A number of epidemiological studies are presented which emphasize the relationship between human illnesses, such as bronchitis, emphysema, and pulmonary edema, and atmospheric pollution. It is concluded from the synthesis of toxicological and epidemiological studies that the noxious nature of the environment is due to a complicated 'mix' of pollutant and meteorological factors. (Author abstract modified)

23151

Nose, Yoshikatsu

RELATIONSHIP BETWEEN PROPERTIES OF AIR POLLUTION AND CHRONIC BRONCHITIS AND ASTHMA AS WELL. (Taiki osen no seijo to mansei kikanshien narabini kikanshizensoku to no kanrensei). Text in Japanese. Yamaguchi Idai Sangyo Igaku Kankyusho Nenpo (Ann. Report Res Inst. Ind. Med., Yamaguchi Med. School), no. 16:13-30, 1969. 74 refs.

The relationship between air pollution and respiratory diseases in the industrial cities of Yamaguchi Prefecture was investigated. Th general nature of air pollution has been changing from settling dusts to gases from the combustion of fossil fuels, and correspondingly, the relative predominance of associated diseases have changed from bronchitis to asthma. In three cities, Ube, Onoda, and Mine (settling dusts), the frequency of bronchitis was higher than in Tokuyama and Nanyo (gaseous pollutants). The frequency of asthma was more or less the same for both groups of cities, but in the gaseous pollution cities, in the areas where both dusts and gases are becoming more concentrated, the frequency of asthma is increasing. The higher concentration of sulfur dioxide seems to be associated with the increase in the asthma affliction rate. Also, there was a significant negative correlation between the frequency of bronchitis and the soluble components such as SO3 and Cl in settling dusts as well as their pH. Various data on air pollution such as are caused by settling dusts and gases, and bronchitis and asthma are tabulated and statistical analyses of data are presented.

23670

Mills, Clarence A.

PUBLIC HEALTH ASPECTS OF AIR POLLUTION. In: California Legislatur Assembly Committee on Air and Water Pollution, Final Summary Report p. 107-111, 1951 (?). 11 refs.

Serious man-made air pollution began with the use of coal as a fuel and especially as a source of power to turn the wheels of the Industrial Revolution. A number of correlations have been made between an atmosphere polluted by coal smoke and pneumonia mortality. In 1930 fog-bound fumes from a zinc smelter and sulfuri acid plant in Belgium killed 60 persons and made hundreds ill. An almost identical tragedy occurred at Donora, Pa., in 1948. In a statistical survey of respiratory deaths in Cincinnati and Pittsburgh, death rates for pneumonia, tuberculosis, and lung cancer were found to be sharply and significantly higher in the dirtier industrial areas of these two cities than in the cleaner residential suburbs. Males are involved much more than females in these effects of pollution. The observation that death rates from buccal and respiratory tract cancers rise along with those from pneumonia and tuberculosis points strongly to a general irritation of the tract as the basic factor involved. Smog irritations of the eyes and throats of the previously well provide a good index of the damaging quality of the polluted atmosphere which cannot be tolerated by the sorely ill. The Los Angeles situation is mentioned, as well as the need for research with respect to pollution damage to community health.

24021

Sherwood, Thomas K.

MUST WE BREATHE SULFUR OXIDES? In: Air Pollution-1970, Part 1. 91st Congress(Senate), Second Session on S.3229, S.3466, S.3546, p. 183-189, 1970. (Hearings before the Subcommittee on Air and Water Pollution of the Committee on Public Works, March 16, 17, 18, 1970.)

A review of the sources and effects of sulfur oxides emissions is presented. Published sulfur dioxide standards conclude that more than 0.1 ppm for 24 hours in any consecutive 100 day period may produce adverse health effects in particular segments of the population. People with bronchitis, emphysema, or lung cancer are highly susceptible to prolonged exposure to SO2. Upper limits on the sulfur content of fuel have been adopted, but the supply is limited. Desulfurization is practical for oils, but not for most coal. Control methods for power plant emissions include limestone injection, wet scrubbing, absorption by inorganic carbonates, adsorption on activated carbon, and catalytic oxidation. Cost estimates in terms of mills per kwh are presented. The future of sulfur control is discussed.

H. EFFECTS-PLANTS AND LIVESTOCK

00316

A. R. Gregory

EFFECTS OF AIR POLLUTION ON EDIBLE CROPS. North Carolina Univ., Chapel Hill, Dept. of Environmental Sciences and Engineering. May 1964. pp. 21-3.

The effects of air pollution on edible crops should be differentiated at the onset from the effects of air pollution on vegetation in general. For example, sulfur dioxide has a very pronounced effect on pine needles, but pine needles are a minor food source. It has been variously estimated by different authorities that the annual loss of vegetable produce amounts to 40 to 60 million dollars. Although this over-kill type of damage is very real to the vegetable producer and is of great economic interest, it is of less concern to those in public health. Their concern is with the damage that alters the content s of crops but does not alter the appearance sufficiently to prohibit their sale. This results in threats to public health through the insidious route of the gastro-intestinal tract. The alterations in edible crops that are usually not apparent to the consumer fall into two categories: (1) loss of nutiirnts such as vitamins, proteins, essential fatty acids, etc. and (2) the addition of some substance to the food which is toxic when absorbed from the gastro-intestinal tract. The loss of nutrients has been established in many cases. Some of the substances which have been shown to produce nutrient damage to produce are: ozone, nitroolefins, perocyacyl nitrates, nitrogen oxides, and ethylene. Of probably greater importance to health now and assuredly in the future is the addition of some toxic substance to the produce. With the advent of possible atomic power plants, Be was studied for toxicity and found to be extremely toxic. It was found that Be taken up into bush beans was not only toxic itself, but decreased the Cu content. In this way it fell into the category of primary toxicant and also into the category of nutrient depletor. Many other compounds also fall into both categories. With the many new insecticides, herbicides and larvicides being manufactured, it has become imperative to be aware of the problem of both the effect on edibles of a toxicant and also its effect on the plant, that is, loss of minerals, vitamins, etc.

01014

G. H. Hepting

DAMAGE TO FORESTS FROM AIR POLLUTION. J. Forestry 62(9):630-634, Sept. 1964. (Presented at North Carolina State of North Carolina Univ., Raleigh, N.C., Apr. 9, 1964, as one of the University's Inst. of Biological Sciences Lecture Series.)

Until a few years ago damage to forests from air pollution consisted mainly of localized but very severe cases of mortality and growth loss due to oxides of sulfur or to fluoride associated with ore reduction, with a minor contribution from other sources. In recent years oxidant damage, attributed largely to ozone in Los Angeles smog, is considered partly responsible for destroying ponderosa pine in the mountains east of that city. Oxidant has also been determined as the cause of a long-known needle blight of eastern white pine now called emergence tipburn, and evidence is accumulating that the eastern white pine disease long known as chlorotic dwarf may be due to an abiotic air-borne agent. Mortality and growth loss of this species has also been occurring within a 20-mile radius of certain power plants consuming large quantities of soft coal. When potted ramets (vegetative reproductions) of selected sensitive white pine clones were exposed in an area embracing an industrial complex in east Tennessee, exposure for seven months resulted in uniformly severe damage. Ramets from resistant trees, similarly exposed, suffered no damage. Sensitive ramets kept out of the affected area remained healthy. New and important types of crop damage, including damage to trees, appear to be resulting from air pollution associated with our enormous urban development, with stack gases from new industrial processes, and with greatly increased emissions of stack gases from industrial plants using fossil fuels at rates far beyond consumtpion only 15 years ago. (Author abstract)

01398

G.H. Hepting

AIR POLLUTION IMPACTS TO SOME IMPORTANT SPECIES OF PINE. J. Air Pollution Control Assoc., 16(2):63-65, Feb. 1966.

In the past, many species of pine have been severely damaged by acute forms of air pollution associated with ore smelting. More recently, damage to ponderosa pine in the State of Washington has been associated with atmospheric fluoride, and this species in particular has also suffered smog damage in southern California. In the East, whie pine has been declining in the vicinity of certain soft-coal-burning power plants, and in one case downwind from an oil-burning power plant; also, throughout the East, an atmospheric oxidant of unknown source has caused a type of needle blight on white pine. Trash burners and city dump combustion have led to the killing of certain pine species, leaving other intermixed pine species unharmed. Localized damage to white pine from automobile exhaust has been observed. Differences in the susceptibility of neighboring trees of the same species to a given air pollutant have been observed repeatedly. (Author abstract)

01589

R. Porter

AIR POLLUTION - EFFECTS AND CONTROL OF POWER PLANT EMISSIONS. Preprint. (Presented to a joint meeting of the Baltimore and National Capital Chapters, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Washington, D.C., Feb. 12, 1964.)

This paper presents a general review of the broad field of air pollution, encompassing such topics as sources of pollution and their implications on living organisms and plants. It discusses the technology of controlling emissions, in particular from power plants, and the Clean Air Act of 1963. This new legislation makes it possible that substantially more of the resources of the Federal Government are placed at the disposal of the Nation.

02293

H.V. Jordan

SULFUR AS A PLANT NUTRIENT IN THE SOUTHERN UNITED STATES. Dept. of Agriculture, Washington, D.C., Agricultural Research Service. (Technical Bulletin 1297). Feb. 1964. 45 pp. GPO

Plants obtain sulfur from several sources-soils, rain or irrigation water, the atmosphere, insecticides, and fertilizers. If supplies are deficient from some or all these sources, crop yields may be curtailed. Soils of the Southeastern States and Arkansas and Texas are highly leached and are low in organic matter, which is the principal repository of sulfur. Sulfur in rainwater and atmosphere originates principally from gases discharged in the combustion of coal. Industrial and home use of coal is relatively minor in large areas of the South. Moreover, coal is being replaced by fuel oil, natural gas, and electricity. As a result, the sulfur obtained from the atmosphere is reduced and the distribution pattern of sulfur is frequently changed. Organic compounds that contain little or no sulfur are replacing sulfur formerly used in cotton insecticides. Sulfur has been an incidental component of many fertilizer materials. However, new fertilizers that are low in sulfur, or even sulfur-free, are coming into use. The Southern Regional Sulfur project was begun in 1952 to study sulfur supplies and requirements for crops and to assess the impact of technological changes on the sulfur supplies and requirements for crops and to assess the impact of technological changes on the sulfur nutrition of crops. The studies were continued through 1960.

02299

J. f. Middleton

PLANT DAMAGE: AN INDICATOR OF THE PRESENCE AND DISTRIBUTION OF AIR POLLUTION. Bull. World Health Organ. (Geneva) 34, (3) 477-80, 1966.

Air pollutants may damage plants and cause death or destruction of tissue with visible pathological symptoms, reduce growth, productivity, and commodity quality, and interfere with biological processes without causing visible injury symptoms. The contaminants responsible for damage may be either particulate or gaseous in nature. The solid particles released into the atmosphere are sometimes the cause of soiling of fruits and vegetables, tissue damage to exposed leaves and fruits, growth reduction; in addition, they add a toxic burden to forage crops used as feedstuffs for livestock. Liquid particles, such as acid aerosols and toxic mists, are sometimes responsible for leaf spotting. The greatest amount of damage to animals and vegetation is usually caused by gaseous air contaminants, which directly injure plants and indirectly injure animals by the toxic effects produced after the animal has consumed contaminated forage and food supplements. This discussion of plant damage symptoms and responses has been directed to the qualitative aspects necessary for assessing the presence and distribution of pollution. As to the evaluation of the concentration and duration of exposure to specific pollutants, experimental systems are available, or can be designed, to meet these specific quantitative needs once the presence of given pollutants has been determined.

05420

Daines, R. H., I. A. Leon, and E. Brennan

AIR POLLUTION AND PLANT RESPONSE IN THE NORTHEASTERN UNITED STATES. In: Agriculture and the Quality of Our Environment. Brady, N. C. (ed.), American Association for the Advancement of Science, Washington, D. C. AAAS-Pub-85, p. 11-31, 1967. 56 refs. (Presented at the 133rd Meeting, American Associaticn for the Advancement of Science, Washington, D. C. Dec. 1966.)

A review of pollutants that have been found to elicit plant response is confined to the discussion of acid gases, primary products of combustion, and products of reactions occurring in the atmosphere. Other topics discussed include: plant response as an indicator of meteorological conditions and the fuels used for heat, light, and power.

06967

PREVENTION OF AIR POLLUTION IN THE STATE OF NORTH RHINE- WESTPHALIA. Ministry of Labour and Social Welfare, North Rhine-Westphalia, Germany)). (Report to the Congrss on the 'Prevention of Air Pollution', Duesseldorf, Germany, Apr. 5-7, 1965.) 78p. Translated from German.

A survey of the activities in North Rhine-Westphalia for the prevention of air pollution is reported and the results are summarized. The report included: (I) history, legal basis, administrative organization, smogwarning network, and economic problems; (II) Report of the Factory Inspection Dept. (Enterprises subject to approval and other enterprises and working places); and (III) report of the State Institute for Air Pollution Control and Land Utilization (monitoring of air pollution, techniques for measuring immissions, relationship between emission and immission, technical steps for the restriction of emissions, and the effect of air pollution on soil, vegetation and animals.

07786

Hansbrough, J. R.

AIR QUALITY AND FORESTRY. In: Agriculture and the Quality of Our Environment. Brady, N. C. (ed.), Norwood, Mass., Plimp- ton Press, AAAS-Pub-85, p.45-55, 1967. 25 refs. (Presented at Meeting, American Association for the Advancement of Science, Science, Washington, D. C., 0DEC. 1966.)

A review which cites examples of injury to forests by specific air pollutants. The source and the nature of the pollutants are discussed. Also, the contribution of trees in combating the air the 133rd. Meeting, American Association for the Advancement of pollution problem is speculated on. As technology changes, trees wherever they grow and for whatever purpose are increasingly subjected to toxic substances in the atmosphere. There is a considerable body of knowledge already available but it is dwarfed by the magnitude of what is not yet known. More information on the nature and source of air pollutants and their present and expected impact on our forest and shade tree resource is necessary.

11733

Executive Office of the President, Washington, D.C., Energy Policy Staff

CONSIDERATIONS AFFECTING STEAM POWER PLANT SITE SELECTION. 133p., 1968. 58 refs. CFSTI: PB 180 741

The present knowledge of the public interest considerations that should play a role in planning the power plants of the future are presented. The physical requirements are discussed for siting the large power plants of the future. Air pollution problems at nuclear plants are minimal. Air pollution control is a most important factor in siting fossil-fueled plants. Existing power plants contribute to air pollution problem primarily through the emission of particulate matter and sulfur oxides but also through emission of oxides of nitrogen. The air pollution problem is described and the air pollution control program of HEW in cooperation with State agencies is outlined. Control equipment is now available to collect some 99 percent of particulate matter. A major research effort is under way to develop economical means of removing the sulfur after fossil fuels are burned and before the resulting gases are emitted to the atmosphere. The techniques for promulgating air pollution standards pursuant to the Clean Air Act of 1968 are described. A major power plant siting consideration is the disposal of waste heat into the Nation's waterways. Power plant siting must be responsive to the increased public concern for the quality of our environment. The rural development considerations in generating station siting are discussed. Other possibilities, including combining a huge plant to convert coal to crude oil with a power station that would be fueled by the by-product char are described. Large energy centers are also being considered in which the power plant would be the hub of an agro-industrial complex. Also presented is a summary of the activities of other State agencies concerned with the quality of the environment, recreation and related matters.

19620

Bashirova, F. N.

CERTAIN CHARACTERISTICS OF INDUSTRIAL AND DOMESTIC CONTAMINATION OF SOIL IN CITIES OF THE KUSNTESK BASIN. (Nekotoryye pokazateli promyshlennogo i bytovogo zagryazneniya pochv v Gorodakh Kuzbassa). Text in Russian. Okhrana Prirody na Urale, vol. 5:79-82, 1966.

Analysis of soil samples taken in and near cities of the Kusnetsk Basin, a coal and metal working center, has revealed significant changes caused by various waste products. Soils were found to contain harmful elements such as lead, and to be poor in nutriment content. The natural composition of soil was found in gardens and parks where cultivation was maintained to a depth 60-130 cm. It is concluded that with proper agronomic measures, these soils can be made to support trees, shrubs, flowers, and grasses.

20982

Spaleny, J.

EFFECT OF FLUE DUST FROM POWER STATIONS ON GERMINATION AND PHOTOSYNTHESIS OF HIGHER PLANTS. (Vliv elektrarenskych popilku na kliceni a fotosyntezu vyssich rostlin.) Scientific and Technical Society, Prague (Czechoslovakia), Agriculture and Forestry Section, Proc. Conf. Effect Ind. Emissions Forestry, Janske Lazne, Czechoslovakia, 1966, p. XXI-1 and XXI-12. (Oct. 11- 14.) Translated from Czech. Franklin Inst. Research Labs., Philadelphia, Pa. Science Info. Services. April 24, 1969.

Experiments were conducted to test the inhibitory effects of certain constituents of power plant dusts on the metabolism of plants. Dust samples provided a total spectrum of the sizes of dust particles. Feeding cabbage was used as the model plant because of its comparatively intensive photosynthetic activity. Germination was realized in Petri dishes located in a thermostat at the temperature of 20 C and exposed to illumunation of 700 lux. Illumination lasted for 8 hrs and occurred every 24 hrs. The water layer in the individual dishes was high enough to cover the seeds without blocking sufficient air access. Acid flue dust (pH 4.3) significantly inhibited both germination and growth. Less acid flue dust (pH 5.3) had no influence, and neutral flue dust (pH 6.4) exerted a positive effect. Results showed that dusting of the upper side of the leaf exerts more influence on the inhibition of photosynthesis than dusting on the lower side of the leaf. This is mostly due to the fact that more flue dust will adhere to the upper side, and both the choking of vents and the light screening from the flue dust layer will be evidenced on the surface of the leaf. Results showed that the soluble component of flue dust also inhibits photosynthesis. Flue dust made wet by water mist is a less active inhibitor of photosynthesis. In a microscopic comparison of dry and wet flue dust, accumulation of dust particles occurs which evidently leads to some dechoking of certain vents, and the dust screen acting against the incident light will be partially decomposed.

I. EFFECTS-MATERIALS

03222

M. Okada, N. Nagai, and K. Ogino.

POLLUTION PROBLEMS ON LIGHTNING ARRESTERS. Text in Japanese Mitsubishi Denki Giho (Tokyo) 40, (9) 1453-67, Sept. 1966.

This paper describes the problems of pollution on lightning arresters due to an increasing number of thermal power stations near the seashore in Japan. It is concluded that overinsulation of the arrester housing does not always correct the situation and sometimes effects the operation of the arrester. Reports on tests of arresters within a contaminated area since 1950 give numerous data on the effect of atmosphric conditions on the characteristics of arresters. This report tabulates the results of the studies and presents a guide to the application of these arresters. (Author summary)

04622

R. H. Boll and H. C. Patel

THE ROLE OF CHEMICAL THERMODYNAMICS IN ANALYZING GAS-SIDE PROBLEMS IN BOILERS. J. Eng. Power 83, 451-67, 1961. (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 27-Dec. 2, 1960)

Part 1 deals with equilibrium concentrations of 29 gaseous and 5 condensed constituents which were calculated for the combustion gases from 2 coals. Temperatures ranged from 440 to 3140 F and fuel-air ratios from 90 to 130% of theoretical air. The 2 coals were selected for their difference with respect to behavior in a boiler. Both are high in S but the Pana, which is especially high in alkali and Cl, produces a highly fouling and corrosive deposit, whereas the Wright contains less of these elements and is innocuous with respect to superheater fouling. In determining the elemental composition of the gases, it was assumed in all cases that: (1) 95% of the nonash S appears in the combustion gas, the remainder going into ash; (2) 40% of the Na content of the coal appears in the gas; (3) 20% of the K content of the coal appears in the gas; (4) all of the K content may be handled as though it were Na; and (5) except for Na, K, and S, no ash constituents enter the combustion gas. Results are presented in graphical and tabular form. Starting from the equilibrium-gas composition results of Part 1, the regions of thermodynamic stability of various Na and Fe compounds are obtained in Part 2 as functions of temperature and fuel-air ratio. It is shown that purely thermodynamic considerations impose an upper temperature limit upon corrosion mechanisms involving complex iron sulfates. The severe fouling tendency of high alkali coals is discussed. By purely thermodynamic means, this study has succeeded in approximately separating the regions wherein accelerated oxidation and sulfation can operate as corrosion mechanisms. Results are in good agreement with experimental observations when allowance is made for probale error in certain basic thermodynamic data, for solution effects and for differences in behavior among the different alkali-metal compounds. Sulfidation is predicted thermodynamically if O2 is excluded from the metal surface. Na2SO4 and Na2Si205 are stable above 1600F in contact with high-alkali combustion gas.

07553

Yocom, John E.

THE DETERIORATION OF MATERIALS IN POLLUTED ATMOSPHERES. J. Air Pollution Control Assoc., 8(3):203-208, Nov. 1958. 34 refs. (Presented at the 14th Annual Conference and 1958 Exhibition, National Assoc. of Corrosion Engineers, San Francisco, Calif., March 20, 1958.)

A group of spcific air pollutants known to produce deterioration of materials, the principal sources of these pollutants, and the most likely mechanisms by which deterioration of a variety of materials can occur are discussed. Specifically, the pollutants are carbon dioxide, sulfur dioxide, sulfur trioxide, hydrogen sulfide, hydrogen fluoride, ozone and solid particulates.

11286

Frey, Donald J., R. C. Ulmer, O. B. Bucklen, and P. Meikle

BOILER TUBE CORROSION. Preprint, Combustion Engineering, Inc. and West Virginia Univ., Morgantown, 15p., 1966. 6 refs. (Presented at the Annual Meeting, National Coal Association Technical-Sales Conferences and Bituminous Coal Research, Inc., Pittsburgh, Penna., Sept. 14-15, 1966.)

High temperature corrosion of coal boiler superheater and reheater surfaces is an industry wide problem. The ideal solution would be to render the coal product shipped to the utility noncorrosive. The remainder of this report discusses a program aimed largely at eliminating corrosiveness of coal but at the same time alleviating its air polluting tendencies as much as possible. An integral part of this project is the establishment of relative rates of corrosion produced by coals of varying physical and chemical properties. Methods of testing and design of test equipment are discussed. Metal wastage occurs as the result of a chemical reaction between the tube surface and a complex alkaliron-sulfate compound, expressed as (K3 or Na3) Fe (SO4)3. Three ingredients are absolutely necessary; sodium and potassium oxides, iron oxide, and SO3; if any one of these three reactants is missing, corrosion will not occur. Attention is also being given to the alkaline earths, calcium and magnesium, since these are known to play an inhibiting role in the corrosive reaction. It is believed that Ca and Mg, in forms reactive with SO3, tie up a portion of the alkalies as double salts (viz. K2SO4.2CaSO4). As such, the alkalies are unavailable for formation of the corrosive compound. In general, the higher the soluble alkali content, the greater the observed rates of corrosion.

13086

Jonakin, James, G. A. Rice, and J. T. Reese

FIRESIDE CORROSION OF SUPERHEATER AND REHEATER TUBING. Preprint, Am. Soc. Mech. Engrs., 8p., 1959. 4 refs. (Presented at the Fuels-AIME (Am. Inst. Mech. Engrs.) Conference, Cincinnati, Ohio, Oct. 26-29, 1959).

At a steam electric station, studies were made to determine the mechanism by which constituents of the coal ash adhere to tubing and how the deposits cause corrosion. The wastage of a particular type of stainless steel alloy was directly associated with ash constituents having low melting temperatures. The relation of metal wastage to metal temperature was found to be a bell-shaped curve with the maximum metal loss occurring at about 1050 to 1150 F. The wastage occurred only under deposits. Sulfurous gases from the flue gas combine with tube deposits to form complex alkali iron sulfates which are molten in the temperature range of maximum metal wastage. Stainless-steel shields were a good temporary measure for the protection of superheater and reheater tubes from deposit-type corrosion.

20820

COMMUNITY AIR QUALITY GUIDES: SULFUR COMPOUNDS. Am. Ind. Hyg. Assoc. J., 31(2):253-260, March-April 1970. 26 refs.

The major sulfur compounds detected in the atmosphere are sulfur dioxide, sulfur trioxide, sulfuric acid, sulfates, and hydrogen sulfide. The chief effects of SO2 are eye and respiratory tract irritation, and increased pulmonary resistance. At concentrations of 87 mg/cu m for 2.75 hours, SO3 proved fatal to guinea pigs. Hydrogen sulfide is a respiratory and eye irritant at low concentrations, and at high concentrations can cause respiratory paralysis. It is believed that sulfur compounds produce a more severe effect when they are adsorbed on a particle small enough to penetrate the lung. Sulfur oxides and hydrogen sulfide can also damage vegetation. Materials such as metals, paper, leather, textiles, paint, and ceramics are also damaged by sulfur compounds. It is suggested that the sulfur oxide concentration in the air kept as low as possible to prevent damage to vegetation, deterioration of materials, and to avoid the presumed adverse health effects. Methods for sampling sulfur compounds and their physical and chemical properties are also included.

J. EFFECTS-ECONOMIC

00166

E. Z. Finfer

SOME TECHNICAL AND ECONOMIC ASPECTS OF RESIDUAL OIL DESULFURIZATION. Ind. Hyg. Rev. 7, (2) 11-20, Dec. 1965. (Reprinted from the J. Air Pollution Control Assoc. 15, 485-8, Oct. 1965.)

Report discusses the sulfur content problem in the area of sulfur fuel oil. Paper deals with the following categories: Sulfur content of residual fuel oil; Sulfur oxide emission; Emission inventory for sulfur dioxide; Effects of contaminants produced from combustion of residual oils; control of sulfur oxide emissions; methods of desulfurization; and desulfurization cost estimates.

00253

J. E. Moody

COAL CAMPAIGNS FOR CLEAN AIR. Coal, 20(2):8-12, 32, Apr. 1966.

It is claimed that the coal industry could virtually be legislated out of business if the severest air pollution control measures being proposed by certain governmental agencies were to be implemented and become models for the entire country. The National Coal Policy Conference. the National Coal Association and the United Mine Workers of America urged that regulations adopted be reasonable and feasible and not such as to damage any industry unnecessarily. The coal groups requested that sulfur control restriction be placed on a stack emission, rather than a coal-input basis so that research on control technique could be stimulated. They also requested that exemptions be granted to certain older plants which, because of limited life projection, could not justify the cost of upgrading particulate control efficiency from 95 to 99%.

00978

A.E. Evanson

POWER OR POLLUTION: THE USE OF LUMBER INDUSTRY WASTE FOR ELECTRIC POWER GENERATION. Preprint. (Presented at the Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

Author discusses the relative advantages of using lumber wastes for power generation. In doing so, this method is compared with nuclear power and hydroelecyric sources. A comparison of costs is presented for the three methods. The consideration of highest priority is the control of air pollution.

01308

M.N. Magnus

HISTORY OF FLY ASH COLLECTION AT THE SOUTH CHARLESTON PLANT UNION CARBIDE CORPORATION - CHEMICALS DIVISION. J. Air Pollution Control Assoc., 15(4):149-154, April 1965.

This report summarizes the installation and operation of fly ash collection and disposal equipment at the South Charleston Plant and includes installation costs, replacement costs based on present-day cost factors, as well as performance data, and maintenance and operating costs. (Author abstract)

01546

J.J. Hanks H.D. Kube

INDUSTRY ACTION TO COMBAT POLLUTION. Harvard Bus. Rev., 44(5):49-62, Oct. 1966.

The responsibilities of individual corporations in air pollution abatement are emphasized. Sources of pollution discussed include the paper, steel, electric power, transportation and petroleum industries. Principal equipment for removal of aerosols and particulates is described. It is concluded that although air pollution equipment increases costs in certain industries, recovery of pollutant, such as fly ash, may help to offset the costs. Government activities in air pollution programs are summarized.

01659

A FEASIBILITY STUDY OF THE RECOVERY OF SULFUR AND IRON FROM COAL PYRITES. Weir (Paul) Co., Inc., Chicago, Ill. May 1966. 42 pp

This report supplements a previous report by the Paul Weir Company on the feasibility of reducing the sulfur content of coals by generally known coal preparation methods. It contains the results of additional data obtained by further investigation with reference to the economic coal. It discusses beneficiation processes required to obtain the proper grade of pyrite; the methods of treating pyrite to obtain sulfur (in the form of sulfuric acid); and the processing of the iron calcines to obtain suitable grades of iron oxide.

01660

AN ECONOMIC FEASIBILITY STUDY OF COAL DESULFURIZATION. WEIR (Paul) Co., Inc., Chicago, Ill. 137, Oct. 1965.

An investigation was conducted of the feasibility of reducing the sulfur content of coals by generally known coal preparation methods together with known costs through case studies. By 'desulfurization' is meant the removal or lowering of the sulfur content of American coals through the removal or lowering of the sulfur content of American coals through known methods of crushing, washing, and various processes other than changing the solid nature of coal, such as through chemical decomposition into gaseous and liquid products. This study is not involved with the removal of sulfur from flue gases. Since the the main source of sulfur dioxide air pollution from coal is the result of its use as 'steam' coal, this study largely concerns itself with United States steam coals as distinct from coals used for metallurgical or coking purposes. Work involved a study of the production, distribution and end use of bituminous and lignitic coals; a study of the proximate analyses of the major coal beds in the United States; a study of the sulfur forms in these major coal beds; an estimate of the reserves and location of high sulfur coal beds; and case studies of current coal preparation practices in preparing steam coals including current costs and suggested methods of coal preparation, using the most modern available equipment together with an estimate of costs for such treatment based upon a 1,000 ton per hour capacity plant.

01679

COAL GASIFICATION APPROACHES PILOT PLANT STAGE. Chem. Eng. News 44, 68-73, Apr. 18, 1966.

Four gasification processes to produce pipeline gas from coal to reach the consumer by 1970 are described. With laboratory investigations and pilot plants being in the planning stage, developers are looking ahead to the ultimate objective of a commercial mine-mouth plant producing 250 million cu. ft. of gas per day to be sold at about 50 cents per million B.t.u. The four processes are: Hydrogasification, carbon dioxide acceptor, molten-salt process, and the two-stage entrained gasification process. Although they are all being developed by private organizations, all are supported at least in part by the U.S. Department of Interior, Office of Coal Research.

01707

D. Bienstock, J. H. Field, S. Katell, and K. D. Plants

EVALUATION OF DRY PROCESSES FOR REMOVING SULFUR DIOXIDE FROM POWER PLANT FLUE GASES. J. Air Pollution Control Assoc. 15, (10) 459-64, Oct. 1965. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965.)

Capital investment and operating costs of three dry processes (Reinluft, catalytic oxidation, and alkalized alumina) for removing SO2 from the flue gas of an 800 megawatt power plant have been projected. Investment costs ranged from $8,510,000 to 17,460,000, and operating costs ranged from $0.75 to $1.44 per ton of coal after charging 14 percent capital charges and allowing byproduct credit for sulfuric acid and elemental sulfur. (Author abstract)

02151

R. Quack.

DUST AND GAS EMISSION FROM THERMAL POWER STATIONS. Die Staubund Gasformigen Emissionen von Warmekraftwerken. BRENNSTOFF-WAERME-KRAFT (DUESSELDORF) 18, (10) 479-86, OCT. 1966.

The capital and operating costs which are incurred in thermal power stations to reduce the emission of dust and gases to a degree tolerable for the environment increase as the demands for the maintenance of clean air by the public and by the authorities become more stringent. After presenting data on the proportion of various fuels used by industry and home heating plants, the author discusses the possibilities for the retention and separation of fly ash, the avoidance of soot and the reduction of sulfur dioxide emissions from power stations for conditions prevailing in the Federal Republic of Germany. (Author summary)

02413

R.M. Jimeson

THE POSSIBILITIES OF SOLVENT REFINED COAL (MASTERS THESIS). (For the degree of Master of Engineering Administration, George Washington Univ., Washington, D.C.) Feb. 22, 1965. 141 pp.

In the preface it is stated that the thesis investigates the competitive market possibilities of solvent refined coal, a reconstituted coal purified to a low ash and sulfur content. Many assumptions had to be made because technical experience in the use of the product has yet to be attained. In general, the author endeavored to make conservative assumptions. Estimates have been made as carefully as possible within the limits of available data. The author, however, has no illusion that time will not prove him somewhat off the mark due to future technological or economic developments. During the course of the investigation, sizeable economic markets for solvent refined coal became apparent, but certain technical unknowns obscured the assurance of these important markets. The prime target for immediate and further research, is to enlighten these unknowns, particularly in those areas with greatest economic potential. Consequently, other than showing prominent market possibilities, the study provides a clear order of importance for further research on solvent refined coal. The final chapter summarizes the market possibilities and suggests a priority of research which will determine the rightful place of solvent refined coal.

02918

F. Felix

NUCLEAR TO DOMINATE POWER PLANT CONSTRUCTION. Elec. World 165, (18) 63-5, May 2, 1966.

Nuclear plants will comprise better than a third of the world's total electric generating capability by AD 2,000. The growing acceptance of nuclear power is apparent, today, in the construction programs of heavy power-consuming nations. Nuclear plant construction will exceed non-nuclear as early as 1980 in some nations; it will move into a similar position for the entire world during the final decade of this century. These projections are derived by techniques developed in 1955, the year of the first Geneva Conference on Peaceful Uses of Atomic Energy, and periodically reappraised subsequently. They are based on such statistical facts as each nation's per capita consumption of electricity, its population growth rate, and the historical or expected service date of its first commercial nuclear power plant.

06845

Brackett, C. E.

AVAILABILITY, QUALITY AND PRESENT UTILIZATION OF FLY ASH. Combustion, 38(11):39-45, May 1967. (Presented at a meeting sponsored by Edison Electronic Inst., National Coal Association and Bureau of Mines, Pittsburgh, Pa., March 14-16, 1967.)

Data on current availability, quality and use of fly ash are discussed. A few of the problems presently facing the industry as a whole and practical methods which can be used to solve some of these problems are discussed. The need for much additional basic research data on fly ash so that a quality product can be produced and sold at all times and under all conditions is emphasized.

07643

Tybout, Richard A.

ECONOMIC ASPECTS OF UNCONVENTIONAL ENERGY RESOURCES. American Chemical Society, Pittsburgh, Pa., Div. of Fuel Chemistry, Preprint, 9(2):31-60, 1965. 66 refs. (Presented at the 149th National Meeting, American Chemical Society, Division of Fuel Chemistry, Symposium on Fuel and Energy Economics Joint with Division of Chemical Marketing and Economics, Detroit, Mich., April 4-9, 1965.)

The two most important unconventional energy resources today are atomic energy and solar energy. Importance here is judged by the ability of these two resources to supply the world's energy load before the end of this century, and is influenced by a lack of resource restrictions for both. An economic analysis of the prospects for nuclear power is given which includes a discussion of cost variables and tabulates cost comparisons of a coal-fired power plant and a nuclear power plant. A similar analysis is presented for solar energy. In addition, three solar power systems are explained. Estimated solar power costs are tabulated for each of these systems. Space heating as a market for solar energy is discussed in detail. Estimated solar heat costs are given for a house Colorado. Nuclear power will be more widely used in the U.S. with recognition of its social costs as well as its economic benefits. It is also conceivable that solar energy will assume some of the space heating load but this will depend on further technological progress.

08059

W. H. Megonnell

AIR POLLUTION CONTROL: ITS IMPACT UPON MUNICIPALITIES, INDUSTRY, AND THE INDIVIDUAL. Air Eng., 9(7):12-14, July 1967. (Presented at the Summer Conference on 'The Demands of Pollution Control Legislation,' Fairleigh Dickinson Univ., Madison, N. J., Aug. 26, 1966.)

The contribution to air pollution by the individual citizen and his financial involvement in abatement and control are discussed. Direct and indirect costs of pollution abatement regulations to the individual are illustrated. The impact of pollution control regulations on industry is examined. Industry's concern should be with the failure of the adoption of uniform regulations and universal enforcement thereof. The problems of sulfurous emissions, control measures, and costs involved are discussed. The responsibility of governing officials of municipalities to aid in pollution control is also discussed. Benefits of pollution prevention, control, and abatement are enumerated.

08867

Katell, Sidney and K. D. Plants

HERE'S WHAT SO2 REMOVAL COSTS. Hydrocarbon Process., 46(7):161-164, July 1967. 7 refs.

Capital and operating costs are estimated for removing SO2 from power plant stack gases based on pilot plant tests of three well known systems. The three systems are (1) the Reinluft process using activated char; (2) the alkalized alumina process and (3) the catalytic oxidation process. The study assumed the use of a coal containing 3 percent sulfur in a powerplant producing 800 Mw of power. The alkalized alumina process requires the lowest capitol investment and operating cost. The catalytic oxidation process requires the highest capital investment and intermediate operating cost, about 15 percent higher than the alkalized alumina. The Reinluft process requires an intermediate capital investment and the highest operating cost of the three processes. Three Japanese approaches, the use of dolomite and limestone, and of phosphate rock are reviewed. Economics will determine the choice of one over the other, but it is conceivable that, depending on location, technical advances, the type of fuel used, and marketing environment for the sale of by-products, all systems may eventually be used.

11111

Ernst and Ernst

A COST-EFFECTIVENESS STUDY OF AIR POLLUTION ABATEMENT IN THE GREATER KANSAS CITY AREA. Preprint, ((18)) p., May, 1968. (Presented at the Kansas City Air Pollution Abatement Con- ference, Kansas City, Mo.)

The cost of achieving various air quality levels in the Kansas City study area under different abatement strategies are estimated. The pollutants of interest in this study are suspended particulates and sulfur oxides. Emissions come from combustion of fossil fuels for space heating and power generation, from open burning and incineration of solid and liquid waste, from industrial processes, and from miscellaneous small sources. Stationary sources account for over 86 percent of the particulates and over 96 percent of the sulfur oxides emitted in this area.

11114

Ernst and Ernst, Washington, D. C.

A COST-EFFECTIVENESS STUDY OF PARTICULATE AND SOX EMISSION CONTROL IN THE NEW YORK METROPOLITAN AREA. Preprint, ((28))p, 1968. (Presented at the Air .pollution Abatement Conference, New York, N. Y. Feb. 1968.)

The annual cost of alternative methods for reducing particulate and SOx emission from power plants, stationary combustion sources, and incinerators is estimated. The alternatives include changing types of fuel and installation of various pieces of control equipment.

11846

Betchtel Corp., San Francisco, Calif.

PROCESS COSTS AND ECONOMICS OF PYRITE-COAL UTILIZATION. Contract PH-86-27-224, ((172))p., Dec. 1968. ((113)) refs.

A method of reducing sulfur oxides emission is to remove some or most of the pyritic sulfur from high-sulfur coals before combustion. This coal preparation step produces clean, low-sulfur coal, but it also yields large quantities of sulfur-containing refuse. The study reviews and compares suitable processes for recovering byproducts and fuel value from coal refuse. A number of methods for recovering products were investigated. The more promising methods were investigated and greater detail. Results are generally positive and indicate that the selected process could economically utilize coal refuse under certain conditions. It also shows that process improvements are possible which could further help the overall feasibility.

11995

Bretschneider, Boris

ECONOMIC CONSEQUENCES OF ATMOSPHERIC POLLUTION DUE TO EXHALATION FROM LARGE THERMAL POWER PLANTS IN CZECHOSLOVAKIA. In: Preprints of the Czechoslovak Reports. International Symposium on the Control and Utilization of Sulphur Dioxide and Fly-Ash from the Flue Gases of Large Thermal Power Plants. Liblice House of Scientific Workers, 1965, p. 226-236.

The economic consequences of pollution caused by thermal power plant emissions can be reliably expressed in numbers; this is especially true for agricultural and forest production. The contribution of emissions to increased living costs, represented for example by higher water consumption and the cost of cleaning or replacing clothing, is more difficult to express in numbers. Determination of the damage to the health of a population is extremely difficult in the absence of sufficiently convincing proof or a method of economic evaluation. However, the growth of the indices of drug expenditures in industrial regions between 1960-1963 suggests that serious attention should be given to this problem. Although it is impossible to calculate or express all the negative consequences of pollution by power plants in precise economic terms, estimations imply that they are enormous. Technology must be applied to limiting the emissions to bearable values.

12418

O'Connor, John R. and Joseph F. Citarella

AN AIR POLLUTION CONTROL COST STUDY OF THE STEAM-ELECTRIC POWER-GENERATING INDUSTRY. Preprint, Air Pollution Control Association, New York City, 25p., 1969. 8 refs. (Presented at the Air Pollution Control Association Annual Meeting 62nd, New York, June 22-26, 1969.)

The results of the National Air Pollution Control Administration's comprehensive survey of the cost of particulate control in the steam-electric power generating industry are presented. The survey, limited to gas cleaning equipment placed in service since January 1958, represents control cost information for 107 collector systems in 60 plants. The aggregate capital investment reported in particulate control equipment, as well as fly ash handling and storage equipment, was approximately $112 million. In addition, the plants spend about $4.6 million annually to operate the equipment and dispose of the collected fly ash. The data obtained reflects a trend toward the exclusive use of electrostatic precipitators, most of which have design efficiencies greater than 98%. As compared to the years 1958-1962, significant reductions in the installed cost per kilowatt of these gas cleaning units are indicated for 1963-1967. As determined by linear regression analysis, the installed cost of a precipitator for an individual boiler can vary widely, due probably to factors such as labor costs, required duct-work, and structural support. Although maintenance and operating costs of a precipitator are fairly constant for a given company, there is considerable variation in the costs between companies. Similarly, the cost fly ash disposal varies widely. Theoretical analysis of a 600 megawett coal-burning power plant shows that the cost of pollution control is 0.35 to 1.0% of the total cost of power to the consumer, including transmission and distribution costs as well as the production costs. This means that, for the average residential electric bill of $120 for a utility with particulate control of 98% or greater, approximately $0.42 to $1.20 is related to costs of control equipment.

13613

Morrison, Warren E.

SUMMARY ENERGY BALANCES FOR THE UNITED STATES. SELECTED YEARS 1947-62. Bureau of Mines, Washington, D. C., IC-8242, 1964. 3 refs.

The production, consumption, and the various forms of energy resources in the U.S. from 1947 to 1963 are discussed. The major sources of commercial energy are anthracite, bituminous coal and lignite, dry natural gas, petroleum, and hydro and electric power. During the 15-year span, the greatest contribution to energy growth came from petroleum and natural gas. Bituminous coal declined throughout the period, and in 1962 ranked third after petroleum and natural gas. The basic energy markets are house hold, commercial, industrial, transportation, and electric utilities.0 Electricity generation by utilities has the fastest growth rate,0 about 5% during 1947-62. Bituminous coal is the majo fuel used0 at power plants. Demand for solid fuels at electric utilities 0increased at an annual rate of 5-1/2% and represents coal's only 0major growth market during the period. Petroleum, including 0natural gas liquids, accounted for 82% of the total raw material 0use of energy resources in 1962, dry natural gas accounte for 013% and solid fuels 5%. It is believed that these findings will be useful for analysis of the energy economy and for projecting or forecasting the country's future energy position.

15510

Lemmon, A. W., Jr., B. L. Fletcher, R. E. Schuler, and H. E. Carlton

A COST-UTILIZATION MODEL FOR SO2-CONTROL PROCESSES APPLIED TO NEW, LARGE, POWER-GENERATION FACILITIES. (Summary Report.) Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Contract PH 86-68-88, 170p., Jan. 17, 1969. 45 refs. CFSTI: PB 182317

A cost-utilization model is presented for estimating the incremental cost of controlling SO2 emissions from large fossil fuel-burning electric power stations by sulfur or sulfuric acid recovery processes. Additional alternatives considered are remote siting, nuclear generation, and low sulfur-content fuels. The model is formulated as a group of algebraic expressions suitable for organizing input data for computer processing. The forms are accompanied by data permitting the selection and entry of the appropriate numerical value in the proper location on a form once a specific SO2 control method is selected. The sequence yields the cost of electricity for the specific process and the expected values of the sulfur removed. A form provided for summarizing the results allows easy comparison of the results obtained for different approaches to SO2 control for any given region in the U. S. Calculations indicate that costs for nuclear generation are competitive with those for fossil-fuel generation. With currently available cost information, costs for SO2 control processes providing for recovery of sulfur or sulfuric acid in new large, power generation facilities should not exceed 0.5 mills/kwhr. Costs would be slightly lower with a high-sulfur content fuel. Because of transmission costs, remote generation does not appear to be a viable alternative.

15889

Kohn, Robert E.

A MATHEMATICAL PROGRAMMING MODEL FOR AIR POLLUTION CONTROL. School Sci. Math., June 1969:487-494. (Presented at the Central Association of Science and Mathematics Teachers, Annual Convention, St Louis, Nov. 30, 1968.)

Mathematical models are proposed for computer processing to determine the least possible cost of pollution controls in an airshed. Advantages of the models are their simplicity, emphasis on economic efficiency, and appropriateness for the type of data normally available. One model considers a hypothetical airshed for a single industry, cement manufacturing. Annual production is 2,500,000 barrels of cement; two pounds of dust are emitted for every barrel produced. The least cost solution to the emission problem would be to install a four-field electrostatic precipitator on kilns producing 1,000,000 barrels and a five-field precipitator on kilns producing 1,500,000 barrels. A second model concerns the five major pollutants in the Saint Louis airshed in 1970: sulfur dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, and particulates. Among the possible control methods included in the model are exhaust and crankcase devices for automobiles, the substitution of natural gas for coal, catalytic oxidation of sulfur dioxide to sulfuric acid at power plants, and the use of low sulfur-content coal. Pollution reduction requirements are itemized. The computer-derived solution of this model indicates the cost and efficiency of each reduction method. A third model evaluates the effects of air pollution on humans, vegetation, and materials. It can be used to determine whether the relative damaging effects of pollutants are proportional to their control cost.

16122

CUT POLLUTION AT WHAT PRICE? Elec. World, 173(3):32-33, Jan. 19, 1970.

Cost penalties for several methods available to reduce pollutants from power plants were discussed. The elimination of thermal pollution probably will have the greatest effect on the cost of power generation. A fossil-fueled power plant rejects about 30% less heat than a comparably sized nuclear-fueled plant. For fossil-fueled plants, the additional cost of mechanical-draft cooling towers over once-through systems is about $5-8/kw of capacity, while for hyperbolic cooling towers, it is about $10-15/kw (1970). The cost of cooling ponds vary appreciably, depending on the site location and soil conditions. In areas where there is little water seepage, cooling ponds can be built for $3-5/kw and where the pond must be lined, the cost is raised to $6-10/kw. For sea-water, wet-type cooling towers and ponds are not feasible. The use of dry towers eliminates the thermal pollution of surrounding waters and gives additional flexibility in site location. Cost studies of dry towers for a 1000-Mw nuclear-fueled unit show that mechanical draft designs would cost from $15-20/kw of electrical output, while hyperbolic designs would range from $25-50/kw. Mechanical and electrostatic precipitators are available with collection efficiencies of 98% for the cleaning of stacks of dust and sulfur oxide emissions. Scrubbing processes can effectively remove 90% of the sulfur oxides from stack gases at a cost of $10/kw. It was concluded that a significant reduction thermal discharge will increase power generation costs about 15% for cooling ponds and 30% for dry towers. These cost increases could have a significant effect on the prices of electricity and other products.

16129

REMOVE SULFUR DIOXIDE AT A PROFIT? Elec. World, 173(4):28-29, Jan. 26, 1970.

A new chemical method is described for scrubbing sulfur dioxide from power plant stack gases and converting it to rechargeable additives and saleable by-products. An economic analysis of such a aystem added to an existing 1200 Mw coal-burning station indicated that revenue from the sale of by-products would cover all operating costs, debt service, taxes, and depreciation, as well as about a third of the utility's customary return on equity. The starting point for the process is the absorber tower to which the flue gas is diverted before entering the stack. Here the gas is scrubbed with a sodium hydroxide solution capable of reducing SO2 content to under 50 ppm. The gas is then passed through a booster fan and reheater and discharged to the stack. The effluent, a solution of mixed sulfur salts, is pumped to a stripper tower, where dilute sulfuric acid is added to oxidize all sulfur compounds to Na2SO4 and drive off the surplus SO2. The latter is collected to become feedstock for the manufacture of sulfuric acid, or to be dried and liquified for sale as SO2. The sulfates then pass into a three-section electrolytic cell in the central region between a porous diaphragm and a nonporous membrane. There the ions are separated by electrolysis, the SO4 radial being drawn to the anode where it combines with hydrogen ions as dilute sulfuric acid, while the sodium ions permeate the membrane to join OH radicals at the cathode and form NaOH. Some gaseous hydrogen and oxygen is also produced at the electrodes. All NaOH from the cathode compartment is recyled to the absorber tower; part of the H2SO4 is recycled to the desorption tower. The pure hydrogen given off can be used to reheat stack gases as they leave the absorber, or sold if the market provides a cheaper fuel for the stack-gas reheater. Surplus dilute sulfuric acid and all pure oxygen can be sold as byproducts. The advantage of the process is that it regenerates all of its chemical feed requirements and avoids the difficulty of disposing of useless residues.

16174

COSTS AND ECONOMIC IMPACTS OF AIR POLLUTION CONTROL FISCAL YEARS 1970-1974. Ernst and Ernst, Washington, D. C. Contract PH 22-68-29, Task Order 2, 321p., Oct. 1969. 26 refs.

A study was conducted to estimate prospective additional costs to the private sector of the economy of controlling air pollution from both stationary and mobile sources during the years 1970-1974. The pollutants considered are particulate and sulfur oxides from stationary sources and hydrocarbons and carbon monoxide from automobiles. Estimates of control conditions prevailing prior to the passage of the Air Quality Act (1967) were taken as a base. Two types of stationary sources are considered: combustion and process. Costs are estimated for controlling three classes of combustion sources: steam-electric power generation industrial fuel combustion, commercial fuel combustion. Industries for which process emission control costs are developed are sulfate pulping, sulfuric acid manufacture, petroleum refining, asphalt batching, hydraulic cement production, steel production, ferrous casting, and nonferrous metals smelting and refining. Only automobiles are included in the mobile source class. Estimates of additional costs to the private sector are developed for nationwide control of sulfur oxides and particulates from stationary combustion sources; nationwide control or particulate from process sources in eight selected industries and of sulfur oxides from sulfuric acid and petroleum refining process; nationwide control of automobile exhaust emissions; and combined control of sulfur oxides and particulates from combustion and process sources in 85 geographical areas. Estimated costs are presented as ranges within which actual costs can be expected to fall. The economic implications of control costs for the nation are discussed. The additional costs range from $0.9 to $1.7 billion dollars for 1970 and rise to $1.0 to $1.9 billion in 1974. (Author summary modified)

16506

Federal Power Commission, Washington, D. C.

UNIFORM SYSTEM OF ACCOUNTS PRESCRIBED FOR PUBLIC UTILITIES AND LICENSEES (CLASS A AND CLASS B). FPC A-5, 166p., March 1965.

A uniform system of accounts for public utilities and licensees as prescribed under the Federal Power Act is given in its entirety. The system of accounts is applicable in principle to all Class A and Class B licensees subject to the Commission's accounting requirements. Various terms are defined. Instructions in regard to electric plants, operating expense, balance sheet, income, operating revenue, and operation and maintenance expense, are provided. Every licensee and every public utility must file an annual report which includes among other things full information as to assets and liabilities, capitalization, net investment, and reduction thereof, gross receipts, interest due and paid, depreciation and other reserves, cost of project and other facilities, cost of maintenance and operation of the project, cost of renewals and replacement of the project works and other facilities, depreciation, generation, transmission, distribution, delivery, use, and sale of electric energy.

17203

Oels, Heinriche

AIR POLLUTION PROBLEMS IN WEST GERMANY AND THE ROLE OF INDUSTRY. (Luftforurensningsproblemer i Vest-Tyskland industriens innsats). Text in Norwegian. Tek. Ukeblad (Oslo), 116(45):1245-1247, Dec. 1969.

West Germany has been occupied in the last decade with reducing emissions of dust and smoke. Effectiveness of dust filters has increased threefold, and filtration is more economical. The dust content can now be reduced to 150 mg/cu m for an emission rate of 100,000 cu m/hr. In 1950, the dust output from the West German cement industry was 3.5% of the clinker produced; in 1967, it was 0.15%. Dust output from the manufacture of calcium carbide was reduced to 3 mg/cu m of exhaust gases. Attention now centers on reducing sulfur dioxide emissions. An electric power plant in Essen absorbs it with a new type of activated carbon, recovering the SO2 for the manufacture of H2SO4, the cost per 1000 kWh being about 1 DM (25 cents), and this can be further reduced. Government standards now limit the sulfur content of fuel oils to 1.8%. About 20% of the total SO2 emission in West Germany comes from sulfuric acid plants. A new 'double contact' process can reduce SO2 emissions of such a plant from 17 to 3 kg per ton of H2SO4 produced. Nitrogen oxides emitted from nitric acid plants have been reduced by 50% with special absorption equipment. New legislation sets a maximum average of 2 mg/cu m for fluorine emissions, or 5 mg for short intervals. Readings as high as 2.7 mg have been recorded above the Ruhr from January 1, 1966, to December 31, 1968. During that period, industry in North Rhine-Westphalia invested 4,000,000,000 DM on air pollution problems related to existent operations and about 275,000,000 DM on those related to new ones. Exhaust purification for the 2-year period cost 3,000,000,000 DM, plus an additional 30,000,000 for research this in comparison with a gross national product of 300,000,000,000 DM per year. The total amount spent by industry is small compared with the damage caused, which amounts to 50 DM per capita per year, or 3,000,000,000 for the entire republic, not including losses due to sickness or sanitation problems.

19685

Scollon, T. Reed

IMPACT OF AIR POLLUTION REGULATIONS ON COAL. Mining Eng., 22(8):67-69, Aug. 1970.

During the past few years the increase in total demand for U. S. bituminous coal has resulted essentially from an increase in demand by electric utilities, which in 1967 amounted to about 58% of all coal shipped to U. S. markets. It is estimated that only about 60 million tons of the utility total was low-sulfur coal, most of which is and will be used for making coke. Between 1967 and 1980 the total demand for U. S. coal should increase by about 150-250 million tons, most of the increased demand coming from the electric utilities. The wide range in the projected increase results from uncertainties in developments in nuclear power and in air pollution regulations and control technology. If control regulations are adopted and enforced on a widespread basis over a short-term period, and if substitute fuels become available, markets for coal could be reduced by more than one-half. Because of the higher mine prices for low-sulfur coals and the greater distances between large industrial coal-consuming areas and sources of low-sulfur coal, the delivered prices of available low-sulfur coals would be much higher than those for high-sulfur coals. If the rate of adoption of regulations were such as to permit the development and installation of sulfur-oxide removal processes, the loss of coal markets would be less severe. Under such circumstances, coal losses would be limited to small industrial plants that are unable to afford removal systems.

20054

Fink, Karel

ECONOMY IN THE PRODUCTION OF THE AIR. (Ekonomika ochrany ovzdusi). Text in Czech. Ekon. Rev., vol. 10:472-476, Oct. 1967.

The economy of air pollution control may be evaluated by comparing the results with needed expenditures. The permissible concentrations are given by valid standards, which in Czechoslovakia are the same as in the Soviet Union. The main substances that compose air pollution are well known; their effects and the way they act are known. For the next 15 years, coal with a high sulfur and ash content will be used; we must use new types of fuels/gas, crude oil/clean oil. Studies show that the power plant situated outside of a coal mine has 11% higher costs, a power plant equipped with devices for neutralizing sulfur has 30% higher costs, and a power plant with crude oil as fuel has 42% higher costs than a power plant that burns brown coal. The amount of exhalation is given as the product of the unit exhalation multiplied by the total amount of burnt fuel. The reduction may be achieved by maximal usage of given heat. Lower figures may be gained with briquettes and coke. A very important factor is the human factor, the training of stokers. Taking into consideration all the above aspects, the question 'how much we shall pay for the protection of air' is changed into 'how much we shall gain in the protection of the air by saving the fuel.'

21241

Fogel, M. E., D. R. Johnston, R. L. Collins, D. A. LeSourd, R. W. Gerstle, and E. L. Hill

COMPREHENSIVE ECONOMIC COST STUDY OF AIR POLLUTION CONTROL COSTS FOR SELECTED INDUSTRIES AND SELECTED REGIONS. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., NAPCA Contract CPA 22-69-79, RTI Proj. OU-455, 414p., Feb. 1970. 360 refs. CFSTI: PB 191054

Costs are estimated for controlling emissions of particulates, sulfur oxides, hydrocarbons, and carbon monoxides from twenty-two sources within 100 metropolitan areas, through the Fiscal period 1970-1975; data defining relevant processes and air pollution control engineering characteristics required to support the analyses are presented. Sources for which control cost estimates were made are solid waste disposal, steam-electric generating plants, industrial boilers, commercial and institutional heating plants, residential heating plants, and the following industrial categories: kraft pulp, iron and steel, gray iron foundry, primary and secondary nonferrous metallurgy, sulfuric acid, phosphate fertilizer, petroleum refining, cement, lime, coal cleaning, petroleum products and storage, grain milling and handling, varnish, and rubber tires. The total investment cost includes $221 million, $1.29 billion, and $1.13 billion to control emissions from solid waste disposal, stationary combustion, and industrial process sources, respectively, while the metropolitan areas for which cost estimates are the highest include the very large, highly industrialized, more northern cities of Chicago, New York, Pittsburgh, Philadelphia, Cleveland, Detroit, and St. Louis. Assuming the 1967 emissions as a baseline, calculations are performed to determine the pollutant removal efficiencies required to bring the emissions into compliance with the standards assumed. (Author abstract modified)

23511

Gerber, Abraham

THE IMPACT OF AIR POLLUTION CONTROL ON THE ECONOMICS OF ENERGY SUPPLY. Proc. Am. Power Conf., vol. 27:103n107, 1965.

For the large consumer of fuel, the cost of controlling the effluen of the products of combustion relative to the total cost of fuel is less than it is for the small consumer, so that effective control measures are more likely to be adopted by the large consumer. However, a given quantity of fuel burned by a large number of small consumers is likely to have a much greater impact on the environment than a similar quantity of fuel burned by a relatively few large consumers. In some cases, such as power plants, the products of combustion are emitted at relatively high effective altitudes and dispersed in the upper atmosphere, while in other cases, such as the automobile or small residential, commercial and industrial establishments, the effluent is emitted at ground level. The ability to substitute one fuel for another in a wide range of uses has resulted in competitive pressure on all fuels to develop the technology that has made possible low cost. Air pollution regulations, especially as they now most frequently appear to be conceived, and based primarily on limitations with respect to the chemical composition of the fuel to be burned, tend to eliminate that desirable competition. Restrictions on the use of coal for electric generation would have the most serious detrimental impact not only on the coal industry--the owners of coal resources and the miners of coal--but would severely impair the economic welfare of important regions of the country. The entire Appalachian region from Pennsylvania to Alabama, as well as the midwest coal region of Illinois, Indiana and western Kentucky, would suffer such adverse economic effects. Even optimistic projections of the rate of progress of nuclear power from its present position with only about 1 and l/2 million kilowatts of capacity, to the FPC projection of 70 million kilowatts by 1980, still leaves us with the need for something in the neighborhood of 800 million tons of coal equivalent to be provided by the fossil fuels.

23800

Shaver, Robert G.

STUDY OF COST OF SULPHUR OXIDE AND PARTICULATE CONTROL USING SOLVEN REFINED COAL. General Technologies Corp., Reston, Va., NAPCA Contract CPA 22-69-82, 68p., April 1970. 26 refs. CFSTI: PB 193420

Cost analysis data are presented for the solvent refined coal (SRC) process in order to facilitate comparison of this method of sulfur oxide control with competing methods. The SRC process, by treatmen of coal prior to combustion, produces a fuel that is water-free, low in sulfur, very low in ash, has a melting point low enough to allow it to be transported as a fluid, and, regardless of the grade of coal used has a heat content of 16,000 Btu/lb, thus lowering shipping costs on an equivalent thermal basis. The potential marke for SRC is difficult to predict largely because its use requires a long-term commitment on the part of producers to process it and on the part of the users, primarily the electric power utilities, to consume it. A level of production necessary for economy requires this. However, the potential benefits of the use of the SRC process rather than a combustion gas treatment process are great, and the special characteristic that allows a minimized combustion plant investment ensures that SRC combustion units, as they age and are changed from base load toward intermittent load use, will be on a much sounder financial basis than those that have combustion gas treatment equipment added on. A processing cost of no more than 10 cents/MMBtu to convert bituminous coal to SRC should allow price-competitive access to over 60% of the current bituminous coal-fired combustion unit market. (Author summary modified)

25961

Frankenberg, T. T.

REMOVAL OF SULFUR FROM FUELS AND PRODUCTS OF COMBUSTION. Preprint, American Society of Mechanical Engineers, New York, 12p., 1965. 9 refs. (Presented at the American Society of Mechanical Engineers Winter Annual Meeting, New York, N. Y., Nov. 29-Dec. 4 1964, ASME Publ. 64-WA/APC-2.)

The removal of sulfur from fuels or the elimination of its oxides from flue gases has been under study for a number of years, but none of the methods tried appears likely to be self-supporting in terms of salable by-products in today's markets. Capital costs of all methods are high and some economic benefit is required to minimize losses incurred in complying with air pollution regulations. A number of approaches have been applied to remove pyritic sulfur from coal. They include electrostatic separation, corona discharge, magnetic separation, reduction by bacterial action, coal benefaction, and coal gasification. Little progress has been made in research in any of these areas. Similarly, none of the methods for removing sulfur dioxide from flue gases is far enough advanced to have a clear prospect of economic justification for power plants. Various wet and dry processes are described and evaluated. Of the dry processes, three at least provide the possibility of a salable by-product. These are the alkalized alumina, Reinluft, and catalytic gas-phase oxidation processes. All need further trials and development to determine their economics.

26193

Industrial Gas Cleaning Inst., Inc., Rye, N. Y.

MANUFACTURERS' REPORT OF AIR POLLUTION CONTROL EQUIPMENT SALES. Contracts CPA 22-69-5 and CPA 70-18, 8p., 1969. NTIS: PB 196028

Air pollution control equipment sales are summarized for the years 1966, 1967, and 1968. Particulate control apparatus includes wet scrubbers, fabric filters, mechanical and electrostatic methods. The number of devices sold and the total amount of money obtained are indicated according to industrial classification. Gaseous control equipment includes catalytic oxidation, direct combustion, thermal oxidation, and an absorber.

K. STANDARDS AND CRITERIA

00167

C. A. Johnson, S. B. Alpert, and A. R. Johnson

H-OIL PROCESSING FOR LOW SULFUR FUEL OIL. Preprint. (Presented at the Economics of Air Pollution Symposium, 59th National Meeting, American Inst. of Chemical Engineers, Columbus, Ohio, May 15-18, 1966.)

The removal of 50-75% of the sulfur in fuel oil can be handled by means of hydrogenation techniques in large H-Oil plants at what appear to be reasonable costs. Economics indicate that processing to effect a moderate degree of sulfur removal would cost 20-40 cents/Bbl. If political-social considerations mandate 90% sulfur removal, available technology cannot handle such a relatively severe treatment at reasonable costs. In U.S. markets, residual fuel oil sold commercially has a sulfur content ranging from 0.4 to 5.2 wt-% with an average sulfur content of 1.6 wt-%. Potentially this burning of heavy fuel adds 1.7-million pounds of SO2 each day to the atmosphere (if all the sulfur in the fuel oil were converted to SO2 when burned). The decision that will have to be faced is whether to produce a product with its sulfur content within acceptable limits or to abandon the market to alternative energy sources such as gas, nuclear power, or the substitution of heavy fuel oil by relatively more expensive distillate fuels. (Author)

02010

E.A.J. Mahler

STANDARDS OF EMISSION UNDER THE ALKALI ACT. Proc. (Part I) Intern. Clean Air Cong., London, 1966. Paper III/12). PP. 73-6.

The evolution of standards of emission under the Alkali Act over the past 100 years is briefly reviewed. The necessity for considering heights of discharge of pollutants as well as their concentration in the emissions and mass rates of discharge to atmosphere is stressed. It is also indicated that standards should be simply and clearly expressed in such a manner that their due observance can readily be checked by short and simple tests. An outline is given of the principles adopted in arriving at the current standards and these, both in regard to concentrations in emissions and heights of discharge, are listed. The aurhor expresses the personal view that present tendencies in ever increasing size of production units and complexity of operations on one site must inevitably lead to necessity in the future further to reduce emissions. Because of the cost of such a step he suggests that setting up and adoption of international standards is a desirable end. (Author abstract)

06696

NEW JERSEY AIR POLLUTION CONTROL CODE (CHAPTER V, CONTROL AND PROHIBITION OF AIR POLLUTION FROM COMBUSTION OF SOLID FUEL - AMENDED). New Jersey State Dept. of Health, Trenton. 3 pp. (Mar. 1, 1966).

This report gives definitions and control and prohibition of fly ash for the state of New Jersey amended standards for the controlled emission of fly ash from the combustions of solid fuels as discharged from stacks or chimneys into the open air.

06778

(INDUSTRY AND ATMOSPHERIC POLLUTION IN GREAT BRITAIN.) Industrie et pollution atmospherique en Grande Bretagne. Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1967.) 6 pp. Fr. (Rept. No. CI 310.) (C.I.T.E.P.A. Document No. 24.)

A summary of the basis of governmental action in Great Britain in the struggle against industrial emissions is outlined. The regulations imposed by the 'Alkali Act' are in most cases based on 'the most practical means.' Standards are given for chimney heights. Statutory limits are given for various materials emitted such as hydrochloric acid, sulfuric acid, nitric acid, hydrogen sulfide, chlorine, arsenic, antimony, cadmium, and lead. The construction of tall buildings tends to reduce the benefits obtained by tall chimneys. A better knowledge of the effects of pollutants should be obtained so as not to burden industry with unnecessary expense in their control. It is urged that international standards for emission be adopted.

09921

Ministry of Housing and Local Government, Great Britain. 27p. 1967.

REPORT OF THE WORKING PARTY ON GRIT AND DUST EMISSIONS.

The working party on grit and dust emissions was set up to advise the Minister of Housing and Local Government on grit and dust emissions from industrial and other similar furnaces. Ways and means of measuring grit and dust emissions and the levels of emission admissible in relation to furnaces burning fuel equivalent to 100 to 50,000 pounds per hr. of coal are presented. Sampling methods and emission levels are given for the following furnaces; solid fuel fired boilers, oil fired boilers and indirect and heating furnaces.

21896

American Society of Mechanical Engineers, New York, Air Pollution Standards Committee

ASME STANDARD APS-2. RECOMMENDED GUIDE FOR THE CONTROL OF EMISSION OF OXIDES OF SULFUR. COMBUSTION FOR INDIRECT HEAT EXCHANGERS. 11p., Jan. 1970. 14 refs.

The three basic methods for controlling pollution of the air by waste materials are reduction in production of pollutants, collection of pollutants, and dispersion of the pollutants in ambient air by air motion. Control usually involves a combination of two or more of these. The philosophy was adopted that the maximum concentration of sulfur dioxide in the ambient air resulting from discharges is of primary importance when regulating ambient air quality. A method is presented for estimating the concentration of SO2 in ambient air based on the stack height, total heat input, and sulfur content of the effluent. An alternate method involving the allocation of emissions among several stacks of equal height is included. The limitations of these systems caused by the presence of large numbers of low level SO2 sources and topographical conditions are considered. Data presented are arbitrarily cut off at 10,000 million Btu/hr on the theory that very large sources will have to take additional factors into account. Abatement is, of necessity, concentrated on effluent control, since the desulfurization of solid fuels has limited potential and desulfurization of liquid fuels requires extensive and costly additions to existing installations. Flue gas desulfurization techniques under development are limited to large installations because of cost and space and may themselves introduce serious problems of disposal of low strength sulfuric acid and/or large quantities of dust.

22248

Padovani, C. and P. Capponi

AIR POLLUTION CAUSED BY HEATING PLANTS; PROPOSAL FOR A NEW INDEX ON WHICH TO BASE EMISSION LIMITS. (Inquinamento atmosferico da impianti termici; proposta di un nuovo indice di riferimento per i limiti alle emissioni). Text in Italian. Riv. Combusti., 21(10):501-505, Oct. 1967. (Presented at the Associazione Termotecnica Italiana, 22nd National Congress, Rome, Sept. 27-29, 1967.)

An index is obtained by dividing the weight of solid particles in waste gases, expressed in grams per cubic meter of dry smoke, by the % volume of carbon monoxide and multiplying by 100. This can be used in calculating the tolerance limits, by assigning a ceiling value of this index based on the carbon content of the fuel and on the heating plant capacity. Previous reference standards include that of the Kommission Reinhaltung der Luft (West Germany, November 1961), which sets maximum dust content on the basis of a graph derived from total ash content of fuel used; that of the Ministere de la Sante Publique (France, October 1964), which bases dust and sulfur dioxide limits on total heat output in Mcal; that of the Department of Health, Education and Welfare (USA, May 1966), also based on a curve of heat output. The weakness of the earlier proposals is that they not only require direct measurement of the amount of fuel burned but also an evaluation of the total output of waste gases. A proposal is also made for establishing a carbon monoxide limit, based on the ratio of carbon monoxide to carbon dioxide. For plants with an output of Gcal/hour, the limit proposed would be a maximum of 20 liters of CO per cubic meter of CO2, assuming standard conditions of temperature and pressure. For plants with an output of 1 Tcal/hour, the ratio would be 10.

L. LEGAL AND ADMINISTRATIVE

00162

E. H. McClelland, 'Compiler'

BIBLIOGRAPHY OF SMOKE AND SMOKE INVESTIGATION (SMOKE INVESTIGATION, BULLETIN NO. 2). Pittsburgh Univ., Pa., Mellon Inst. of Industrial Research and School of Specific Industries. 1913. 106 pp.

General subject categories include: (1) Effect on vegetation; (2) Physiological effects; (3) State and local air pollution legislation in the U.S.A. The first two categories consist predominantly of references to German periodical literature, but also include references to American, British and French literature.

00206

J. W. Gardner

CONTROL OF AIR POLLUTION ORIGINATING FROM FEDERAL INSTALLATIONS AND STANDARDS BY THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE IMPLEMENTING THE OBJECTIVES PRESCRIBED BY THE ORDER. EXECUTIVE ORDER 11282. Dept. of Health, Education, and Welfare, Washington, D.C. May 26, 1966. 6 pp.

The article specifies the overall policy, procedures for new federal facilities and buildings, and objectives for federal facilities and buildings insofar as air pollution control is concerned. In addition, standards to be used in this new order are delineated by Secretary Gardner. The categories to which the article alludes are: combustion of fuels, Stacks, Storage and handling of fuels and ash, and disposal of trash. In each instance are specified limits and means to measure the amount of pollutant covered by the above categories.

00311

AIR POLLUTION (A SURVEY OF EXISTING LEGISLATION). Intern. Digest Health Legislation 14, 187-229, 1963.

This report contains a comparative survey of existing legislation for the control of atmospheric pollution, and discusses specific laws and regulations of following countries: Australia, Belgium, Canada, Chile, Czechoslovakia, France, Federal Republic of Germany, Ireland, Jamaica, New Zealand, Poland, England and the Inited States.

00973

A COMPILATION OF SELECTED AIR POLLUTION EMISSION CONTROL REGULATIONS AND ORDINANCES. (REVISED EDITION.) Public Health Service, Washington, D.C., National Center for Air Pollution Control 143p., 1967.

The regulations and ordinances have been arranged in sections which include Smoke Emissions and Equivalent Opacity Regulations, Regulations Pertaining to Particulate Emissions from Fuel Burning Plants, Regulations Pertaining to Particulate Emissions from Refuse-Burning Equipment, Regulations Pertaining to Particulate Emissions from Manufacturing Processes, Regulations Pertaining to Sulfur Compound Emission Control, Regulations Pertaining to Hydrocarbon Emission Control, Regulations Pertaining to Fluoride Emission Control, Regulations Pertaining to Motor Vehicle Emission Control, Regulations Pertaining to Odor Emission Control, and Zoning Ordinances. The regulations and ordinances represent the different methods of controlling emissions by law and varying degrees of control. Some definitions were picked selectively to provide very good definitions while others were picked because of their wide use by many states and communities.

01265

A. J. Benline

AIR POLLUTION CONTROL PROBLEMS IN THE CITY OF NEW YORK. Trans. N.Y. Acad. Sci. 27, (8) 916-22, (june 1965.

A general discussion is presented of: control methods; pollutants and their sources; and the need for adequate administrative tools in relation to New York City's control program.

01399

W. Wronski, E.W. Anderson, A.E. Berry, A.P. Bernhart, H.A. Belyea

AIR POLLUTION CONSIDERATIONS IN THE PLANNING AND ZONING OF A LARGE RAPIDLY GROWING MUNICIPALITY. J. Air Pollution Assoc., 16(3):157-158, Mar. 1966.

In the Municipality of Metropolitan Toronto which covers 240 square miles there are over 600,000 automobiles, 350,000 domestic and industrial oil and coal-burning installation, 5000 apartment and industrial incinerators, and other numerous sources of air pollution level. The area includes 13 municipalities comprising Metropolitan Toronto and 13 additional surrounding urban and rural localities in an area of 720 square miles. The population of the planning area is 1,965,000 and is expected to increase to 2,800,000 by 1980. The Planning Board showed its recognition of the problem by a statement of policy designed to reduce pollution from fuel-burning equipment and incinerators, to develop a coordinated transportation system, to encourage central heating plants, and to control apartment development in mixed commercial areas. The Board advises and assists the individual planning boards, and building and property departments. (Author abstract)

01585

W.H. Megonnell

IMPACT OF POLLUTION ABATEMENT REGULATIONS ON INDUSTRY AND MUNICIPALITIES. Public Health Service, Washington, D.C., Div. of Air Pollution. (Presented at Summer Conference on 'The Demands of Pollution Control Legislation,' Fairleigh Dickinson Univ., Madison, N. J., Aug. 26, 1966. GPO 913-059

This is a general review of the impact of air pollution control regulations on the economics of the Nation and its indirect effect on the individual citizen. The costs of air pollution abatement to industry, and air pollution abatement and impact in the New York New Jersey area are discussed in particular. Problems arising from SO2 emissions and proposals for remedial measures are emphasized.

01590

R. Porter

AIR POLLUTION ABATEMENT THROUGH COAL RESEARCH. Preprint. (Presented to the Technical Advisory Committee, Office of Coal Research, Dept. of Interior, Washington, D.C., Nov. 30, 1965.)

The impact of the Clean Air Act on control activities within State and local governments is reviewed and the most important new programs discussed in some detail giving also figures on costs. The activities of the Office of Coal Research, supported by the Division of Air Pollution, and their investigation of the economics or producing very low sulfur fuel from coal, as well as the activities of other cooperative efforts, as the conversion of pyrite in coal to a magnetic form to permit its removal by magnetic tape, one of the several cooperative projects of the Bureau of Mines. The Division has also encouraged work leading to development of various dry stack gas scrubbing processes which are discussed. The need for development of clean power cycles is emphasized and those availabe described. Publications of the Division assisting in design operation or control of specific industries or processes which constitute potential sources of air pollution are mentioned. Long range research on new power systems for vehicular propulsion is also highlighted.

01654

A.C. Stern

THE REGULATION OF AIR POLLUTION FROM POWER PLANTS IN THE UNITED STATES. Rev. Soc. Roy. Belge Ingrs. Ind., Brussels (Presented at the International Symposium on Immission Regulations, sponsored by the Haus der Technik E.W. Essen and the Arbeits -und Sozialministerium (Dept. of Labor and Social Welfare) of North-Rhine-Westfalia, Essen, Germany Mar. 9, 1966; and before the Societe Royale Belge des Igenieurs et des Industriels, Brussels, Belgium, Mar. 16, 1966.)

Author discusses the types, concentrations, and levels of control (state, federal and local) that the United States has initiated for the abatement of air pollution from power generating sources. Statistics are presented for various localities as well as specific pollutants which are emitted. The Clean Air Acts (88-206 and 89-272) as they apply to the abatement of air pollution are explained.

01890

Williams, J. D., G. Ozolins, J. W. Sadler, and J. R. Farmer

INTERSTATE AIR POLLUTION STUDY: PHASE II PROJECT REPORT. VIII. A PROPOSAL FOR AN AIR RESOURCE MANAGEMENT PROGRAM. Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, 132p., May 1967. 7 refs

This report is devoted to the development of an air use plan for the St. Louis metropolitan area. An air use plan may be thought of as a link between the potential pollutant emissions of a community and the air quality goals. Its function is to optimize the use of the air with respect to the amount of pollutants emitted, by considering the dilution capacity of the air basin and the configuration of the pollutant sources in the area. The air use plan may then be used as the basic framework for achieving the desired air quality by the various means available such as limiting the emissions from individual sources, limiting the emissions from sources in certain areas, or even disallowing new pollution sources in overburdened areas. In short, it provides the basis for enacting control regulations and provides a guide for future planning activities.

02011

A. Laamanen L. Noro

THE AIR POLLUTION SITUATION AND SPECIAL PROBLEMS IN FINLAND. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper III/13). pp. 77-9.

Owing to its favourable climate and a low population density Finland still has, on the whole, a clean atmosphere, but industrialization and urbanization are beginning to change this situation. This paper records and discusses the results of investigations and researches. (Author abstract)

02052

A. J. Clarke, G. Spurr, and S. Catchpole.

TOWARDS A CLEAN AIR POLICY. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/16). pp. 203-5.

The paper considers some fundamental concepts of a rational clean air policy, and stresses that the control of ground level concentrations should be the primary concern. The basic relationship determining ground level concentrations includes both the rate and effective height of emission, both of which must be taken into account in an effective control policy. Furthermore, the latter should permit flexibility in selecting the method of control most suited to the circumstances, including feasibility and cost. The principles applied by the Central Electricity Generating Board (C.E.G.B.) to the control of smoke, dust and sulphur dioxide from power stations are described. Recent advances in the design of plants include the development of the single tall multiflue chimney. Air pollution surveys and measurements, both in the vicinity of power stations and nationally, have demonstrated the effectiveness of the clean air policies practiced by the C.E.G.B. (author abstract)

02831

NEW JERSEY AIR POLLUTION CONTROL CODE (CHAPTER I THROUGH VI). New Jersey State Dept. of Health, Trenton. Jan. 1962. 6 pp.

Chapters 1 through 6 of the New Jersey air pollution code are presented: 1. Definitions. 2. Control and prohibition of air pollution from refuse disposal and salvage operations. 3. Municipal ordinances or regulations. 4. Control and prohibition of air pollution by smoke. 5. Control and prohibition of air pollution from combustion of solid fuel. 6. Prohibition of air pollution.

02960

J. M. Leavitt

AIR POLLUTION STUDIES AND CONTROL: TVA COAL ELECTRIC GENERATING PLANTS. Proc. Ann. Sanitary Water Resources Eng. Conf., Vanderbilt Univ., Nashville, Tenn., 1965. pp. 200-7.

The various aspects of the TVA air pollution control program are discussed in four general categories: (1) air pollution prevention, (2) air pollution monitoring, (3) air pollution surveillance, and (4) air pollution special studies.

03277

R. F. Bovier, A. J. Tigges, W. A. Verrochi, and W. H. Lambert.

SOLVING A VALLEY AIR POLLUTION PROBLEM. Preprint. (Presented at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 15, 1961.)

Seward Generating Station of the Pennsylvania Electric Company is a coal-fired, mine-mouth operation. The station is located in a broad valley subject to frequent stagnations and ground fogs. It has 12 boilers supplying steam to 5 turbine generator units with a net capability of 280 megawatts. Air contamination became a significant problem when the newest unit was added in the spring of 1957. The electrostatic precipitator operated far below its guaranty of 95% collection efficiency and the smoke plume was therefore quite dense. A short stack, 200 feet high, and a low stack exit velocity, 40 feet per second, compounded the problem. Since the new unit represented almost 50% of the total generating capability of the station, its emission of fly ash and stack gases was appreciable. This problem served to focus our attention on the fact that the dust collecting equipment for the old boilers was in many respects inadequate. Penelec initiated a continuing program for evaluating and controlling stack emissions, and to coordinate it. The public relations; research and development; air sampling survey; and the station modifications and additions are discussed.

03359

AIR POLLUTION IN NEW YORK CITY (INTERIM TECHNICAL REPT. M-970). New York City Council, Special Committee to Investigate Air Pollution. June 22, 1965. 74 pp.

Authors cover the following topics of air pollution as they relate to New York City: (1) air quality a statistical analysis, (2) The effects of air pollution on health as well as agricultural and plant life, (3) The major sources of air pollution in New York City, covering categories such as fuel combustion in stationary sources, vehicular exhaust, refuse combustion, industrial processes, and emission calculation, (4) The influence of weather, (5) and analysis of air pollution control program.

03452

SOMETHING IN THE AIR (A REPORT ON AIR POLLUTION IN ILLINOIS). Illinois Dept. of Public Health, Springfield. 1956. 74 pp.

This is a review of air pollution problems in general and problems concerning Illinois in particular. Requests from State and local agencies, educational institutions and from cities for legislation to protect the public from long-time health hazards resulting from the pollution of the environment, are included. Institution of control programs seems to be a complex matter involving all parts of the Illinois communities.

05105

HEW CRACKS DOWN ON SO2 IN BIG CITIES. Oil Gas J. 64 (48), 54-5 (Nov. 28, 1966).

Fuel standards may be controlled in federal buildings. Next will come airsheds in metropolitan areas under HEW's authority to deal with interstate pollution. Finally, the agency will issue clean-air guidelines for state and local control agencies. The U.S. is prodding local-government units to fill the gaps left in federal authority and is providing funds for such work. Where coal and fuel oil will lose markets, the main winner should be natural gas, which can meet the low-sulfur test. No. 2 and 4 fuel oil should benefit to a lesser degree. Resid producers will probably hold some business by lowering the sulfur content of their fuel while raising their prices to pay for processing. The Government also is moving to enforce ceilings on auto emissions, already set starting with 1968 models. HEW Sec. John W. Gardner said the internal-combustion engine, the major market for U.S. refiners, was on a collision course with the nation's drive for cleaner air.

05499

M. Katz

AIR POLLUTION IN CANADA. Proc. Clean Air Conf., Univ. New South Wales 1, 23-40 (1962).

Air pollution trends in Canada, as in other countries, are influenced by the growth and distribution of population and industry. Increasing efforts have been made by industry and government agencies to control the emissions of sulphur compounds from smelting, oil refining and sour natural gas processing operations through the recovery of useful by products such as sulphuric acid and fertilizer products or elemental sulphur. A number of elemental sulphur plants have been erected within recent years to utilize the hydrogen sulphide recovered from the purification of sour natural gas for pipeline distribution systems. These sulphur plants vary in daily capacity from less than 300 to over 1000 long tons. Research at the federal level in Canada on the toxic effects of air contaminants and related problems of sampling, methods of analysis and identification are centralized largely within the Occupational Health Division of the Department of National Health and Welfare. Divisional activities are organized into two main units of environmental assessment and biological studies. An increasing number of industrial companies are becoming aware of the importance of air pollution as a factor in existing and new manufacturing operations. This enlightened attitude on the part of management has resulted in the undertaking of air pollution surveys before and after the construction of their plants, in the assessment of sources of emission to abate or eliminate air pollution problems and in studies to determine the suitability of various sites from an air pollution control standpoint.

06188

Larsen, Ralph I.

DETERMINING REDUCED-EMISSION GOALS NEEDED TO ACHIEVE AIR QUALITY GOALS--A HYPOTHETICAL CASE.J. Air Pollution Control Assoc., 17(12):823-829, Dec. 1967. 37 refs. Presented at the Annual Meeting, Air Pollution Control Assoc., Cleveland, Ohio, June 11-16, 1967.)

Air management steps involved in determining reduced-emission goals include determining the effects of various pollutant concentrations on man, animals, plants, and property; deciding which effects to prevent; selecting ambient air quality goals that will prevent these effects; measuring and evaluating pollutant concentrations from sources and in the ambient atmosphere; calculating overall source reductions needed to achieve selected ambient air quality goals; and finally, determining reduced-emission goals for the various source types. Examples are cited of the various decisions and actions involved in determining a set of reduced emission goals for stationary and mobile combustion sources.

06615

Frankenberg, T. T.

TRENDS IN AIR POLLUTION LEGISLATION AND IN PRECIPITATOR DEVELOPMENT. Preprint, American Electric Power Service Corp., New York, N. Y., 11p., 1965. 5 refs. (Presented at a meeting of the Southeastern Electric Exchange, Miami Beach, Fla., Oct. 22, 1965.)

Public sentiment, local and state laws, and finally the entrance of the federal government into control and enforcement make it certain that air pollution will demand more attention from design engineers and plant operators in the electric utility industry. The trend is toward much stricter limits on particulate emission, and these become even more stringent for very large fuel users. Most of the new limits are set in terms of pounds of emission per million Btu of fuel input. While restrictions are five times more stringent than fifteen years ago, developments in precipitators have moved at a more leisurely pace. Some significant improvements in electrical equipment have been made. It is suggested than an equal improvement can be achieved by closer attention to the purchasing of electrostatic precipitators, and by testing them to determine that the required conditions are actually met. Gaseous pollution should never be forgotten when discussing the role of particulate emission and its control. High stacks can be useful in both areas, and codes should be written to take proper cognizance of the fact.

06686

H. F. White

REVIEW AND EVALUATION OF PROJECT FUEL CELL. Jackson & Moreland, Boston, Mass. (Rept. OCR 17.) Contract No. 01-0001-500.) 94p., b8dec. 1966. CFSTI: PB 173765

A coal-oxidation, solid-electrolyte, fuel-cell power plant has the potential for becoming a competitive source of supplying electrical energy for heavy industry and in the utility power field. The authors summarize the current status of development of thin-film battery components and the manufacturing techniques and describe a proposed 100-kw plant presently under design. The results of the research program are most encouraging; suitable materials for battery components have been determined and much work is directed toward optimization, refinement and improvement. Project Fuel Cell is still in the experimental stage and the solution of many problems still remain. The authors project a basic cell having a current density of 950 milliamperes per square centimeter (800A/sq ft). This is four times the density planned for the 100-kw plant, but has been obtained in laboratory tests. As many individual fuel cells as desired can be deposited and series-connected on a single thin-film battery. Economic practicability of coal gasification has not been proven. The authors also discuss some of the problems that may be encountered in the auxiliary coal, ash, and gas-fuel handling systems as well as modifications that will be required in commercially available equipments normally used in similar processes. Consideration was given to a plant rated approximately 200,000 kw to serve as a prototype for final commercial designs. The authors estimate the cost of 20,000 kw fuel-cell power plant for use as a prototype and as the final step to establish commercial feasibility to be approximately $7,000,000. The cost of operating and testing the plant is estimated to be $1,000,000 per year. Fuel-cell power systems appear ideal for supply of bulk dc power to processes found in the electrochemical and electrometallurgical industries. In addition, fuel-cell power systems look extremely attractive as a base load supply in the utility-power field. Estimates are included that project bus car costs (in case of the 1000-MW plants at 345 kVac).

06730

J. H. Ludwig

STATUS OF CURRENT TECHNOLOGY IN THE CONTROL OF EMISSIONS TO THE ATMOSPHERE. 90th Congress 'Air Pollution--1968, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. p. 2274-7.

A tabulation is presented of the ststus of control technology for a wide range of industries. An indication is given of the presence or absence of control technology for particulates, sulfur oxides, carbon monoxide, and other pollutants. Remarks are provided regarding the difficulty or necessity of control for the various pollutants in the various industries.

06735

J. R. Garvey

TESTIMONY BY J.R. GARVEY REGARDING THE AVAILABILITY OF LOW-SULFUR COALS. 90th Congress ('Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. p. 2409-12.

Bituminous coal accounts for 96% of current production capacity and 21% of the low-sulfur reserves. Because of location near the market it is used by electric utilities and other industries. Data on the availability and production of bituminous coal are divided into three groups by states and tabulated to illustrate the relationship of location of low-sulfur bituminous reserves to current production. Industrial use of this coal is discussed. Because of the location of the reserves in relation to the market and the location of currently producing mines, the possibility of substituting low-sulfur coals for high-sulfur coals cannot be considered more than a temporary expedient in air pollution control. An arbitrary decision to restrict the use of coal to that containing 1.0% sulfur, or less, would have a tremendous social and economic impact.

06737

J. Jonakin

STATEMENT OF J. JONAKIN FOR THE SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION. 90th Congress Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution 'Air and Water Pollution--1967, Part IV (Air Quality Act)' May 15-18, 1967. p. 2473-82.

After studying the various sulfur dioxide removal processes, it was concluded that a system most acceptable to the utility industry would probably be one that did not involve the operation of chemical recovery equipment and one that could improve operating performance of the power-plant. A system utilizing an additive, that could neutralize the corrosive combustion products and that would form a disposable compound with the sulfur, was thought to be a logical approach. It was decided to explore the possibility of developing a system using dolomite or limestone. The system developed by Combustion Engineering, Inc., is shown in a diagram. This system involves the feeding of an additive (dolomite) into the furnace and wet scrubbing the flue gas leaving the air heater. In pilot plant studies 98-99% SO2 removal and 98-99.6% dust removal were obtained. In a field trial in a commercial size unit completely satisfactory furnace operation was obtained while injecting dolomite. SO2 removal was maintained at a level of 95% or better. Cost calculations are discussed for the installation of a system for removal of both SO2 and particulate matter from a 500,000-kw coal-burning unit.

06739

S. K. Reed

STATEMENT OF S.K. REED FOR THE SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION. 90th Congress ('Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. pp. 2504-10.

The FMC Corporation, under a contract with the Office of Coal Research, developed a process called COED (Char Oil Energy Development). This involves treatment of coal to produce an oil, a char, and a gasoline. It was found that hydrogen was formed as a by-product of the COED process. The development of a process to utilize this hydrogen to remove sulfur from the char is described. It is claimed that the resultant char contains 0.3% sulfur. The economics of the process are discussed and it is proposed as a source of low-sulfur fuel.

07550

Philadelphia Dept. of Public Health, Pa.

AIR POLLUTION FROM FUEL COMBUSTION PROCESSES IN PHILADELPHIA. Preprint, 8p., Sept. 1966.

The combustion of fuels is the greatest single source of air pollutant emissions within a metropolitan area. As much as 80% of the total weight of pollutants discharged to the atmosphere result from the burning of fuels for electrical power generation, for industrial and commercial heat and power, for domestic heating, and for vehicular power. The purpose of this report is to summarize the present status of the problem in Philadelphia and to recommend necessary regulations and other action required to deal with the problem.

07794

Jones, James R.

COAL AND AIR POLLUTION CONTROL. Proc. Illinois Mining Inst., p. 74- 90, Oct. 1966. (Presented at the 74th Annual Meeting, Illinois Mining Inst., Springfield, Ill., 1966.)

In the control of air pollution, coal producers are primarily concerned with two emissions: 1. particulates or fly ash from fuel combustion, and 2. sulfur oxides from boiler stacks. These emissions, available control equipment, the efficiencies of performance, and the economics involved are discussed. The requirements for meeting the current proposed codes are discussed.

07950

F. G. Sugden

LOCAL AUTHORITY PROBLEMS IN AN INDUSTRIAL AREA. Roy. Soc. Health J. (London), 87(4):204-214, July-Aug. 1967. 5 refs.

The history of air pollution control in Britain under The Alkali b8works Act of 1863, the Public Health Act of 1875, and the Clean Air Act of 1956 is presented along with a review of current problems in the measurement and control of air pollution which confront local authorities in industrial areas. Until 1946, the standard deposit gage was commonly used for measureing air pollution. Some of the instruments had been in use sincethe 1920's. Since the Second World War, air filters which permit daily readings of smoke and sulfur dioxide have been used although deposit gages continued in use. The use of deposit gages was unfortunate since local authorities did not measure the trend in grit and dust deposition which are an important part of total air pollution. Results should be studied on the basis of 3,4 or 5-year moving averages to level out meteorological variations in any one year. Smoke from industrial sources seems to come primarily from steam raising plants and the control of dark smoke is delegated to the local authorities. Suggestions are made for changes in the Clean Air Act to require more information in regard to new installations. The burning of material in the open should be brought under the dark smoke regulations. The most prolific grit producer subject to local control i s the cold blast cupola. In 1963, more than 1/2 the arresters fitted to the larger cupolas were the dry type and 18% had no arresters. The amount of SO2 in the air will increase unless there is an increase in the use of low sulfur fuels. The ground level control of SO2 is based on proper chimney heights. Since domestic smoke is responsible for much of the smoke pollution, further diminution depends on increased implementation of smoke control orders. In spite of past accomplishments, much remains to be done.

08062

Schildhammer, Allen

A. Schildhammer

AIR POLLUTION CONTROL ACTIVITIES ARE NOTED FOR 23 INDUSTRY AREAS. Air Eng., 9(6):28-34, 37, June 1967. AREAS. Air Eng., 9(6):28-34, 37, June 1967.

A spot check of air pollution control activities in key industrial

A spot check of air pollution control activities in key industrial areas throughout the United States and Canada areas throughout the 1nited States and Canada shows that industry, by and large, is coope:ating to a great extent in shows that industry, by and large, is cooperating to a great extent in investing in abatement devices. The survey also indicates that investing in abatement devices. The survey also indicates that Air &ollution Control Authorities are becoming more Air Pollution Control Authorities are becoming more active and vigorous in their activities to evaluate their local and regional actibe and vigorous in their activities to evaluate their local and regional air pollution problems. On the whole the budgets for air pollution problems. On the whole the budgets for the Authorities are on the increase, and this is coupled with the Authorities are on the increase, and this is coupled with increases in Federal grants. Also, many states, regions, and cities which did not have adequate air pollution control laws and cities which did not have adequate air pollution control laws and regulations are updating those already on the books, and regulations are updating those already on the books, and passing new ones to keep abreast of new technology and current developments passing new ones to keep abreast of new technology and current developments in this field. The industrial areas included in this in this field. The industrial areas included in this second annual survey are : Little Rock, Arkansas, Seattle-King second annual survey are: Little Rock, Arkansas, Seattle-King County, Washington, 'ouston, Texas, Miami(Dade County), County, Washington, Houston, Texas, Miami (Dade County), Florida, Chicago, Illinois, Portland, Oregon, Vancouver, British Columbia, Cincinnati, 3hio, Gary, Indiana, St. British Columbia, Cincinnati, Ohio, Gary, Indiana, St. Louis, Missouri, Minneapolis, Minnesota, Oklahoma City, Louis, 7issour, Minneapolis, Minnesota, Oklahoma City, Oklahoma.

08686

Harris, D. N.

REDUCING SULFUR EMISSIONS. Combustion, 39(5):36-38, Nov. 1967.

The status is presented of the following programs carried out by APIs Subcommittee on Sulfur: stack removal of SO2; reactions of sulfur oxides in stack plumes, ambient air monitoring and data analysis; engineering study of New York City air quality situation; and desulfurization costs residual fuel oil. The conclusions reached from each program are summarized.

09073

Mayor's Task Force on Air Pollution, New York, N.Y.

SPECIAL REPORT TO MAYOR JOHN V. LINDSAY. Preprint, 15 p., May 9, 1967.

New York City's campaign against air pollution since the submission of the Task Force Report one year previously is evaluated. The main point emphasized in the May 9, 1966 report of the Task Force was that New York City is moving -- far more swiftly thanmost people realize -0 toward a major air pollution disaster. This warning needs not merely to be reemphasized. It must serve as the basis for an emergency action program of mammoth dimensions. Let it be said at once that only by multiplying the present effort many times--on the Federal, Regional, and City levels--can New York be kept from becoming unhabitable within a decade. This problem is not confined to New York. In fact, during the past year, the air-pollution danger has exploded beyond the large cities and has now become one of the most urgent problems facing the nation as a whole. No greater mass fallacy exists than that there is an infinite supply of fresh air. Fresh air is a limited resource. It can be depleted if the natural balances are upset. A vast acceleration of anti-pollution planning and activity -- national, regional, and local -- is now critically needed if our cities are to remain safe and fit for human habitation. The Federal goverment must play a major part in such a total program. The reason for such a vast expansion is clear. No municipality or even region has the resources for a carrying out of all the measures essential to cope with the increasing sources of pollution.

09443

THE COAL PICTURE...1967-1968. Coal Age, 73(2):50-59, Feb. 1968.

The utilization of coal is expected to increase in 1968 despite oil, gas, and nuclear competition and is expected to continue rising in the near future. Several developments which occured during 1967 regarding air pollution and the coal industry are discussed. The drive for restrictions on sulfur in coal and oil, spearheaded by the Dept. of Health, Education and Welfare and its Public Health Service was marked by, among other things, attempts to establish a national criterion of 0.1 parts per million for sulfur oxides in the air, and accelerated promotion of nuclear, gas and low-sulfur oil fuels. At the same time, however, there was increased emphasis on research into ways and means of reducing the sulfur content of coal and fuel oil, and for removing it to acceptable levels in the combustion process. HEW actively participated in a number of state, regional and local campaigns. State and local actions generally resulted in 1.0% as the sulfur limit, with some prescribing as low as 0.2% in 3 to 5 yr. Sulfur oxides control was the major objective, however fly ash control was also a target of pollution-control programs.

09445

Comprehensive Planning Bureau, Japan, Osaka Municipal Office

AIR OVER OSAKA CITY. 93P., 1967

The location, geographical features, population, manufacturing, and administration of Osaka City are discussed. An extensive discussion of the measurement of air pollution is presented. The sampling networks and measurement of dustfall, sulfur dioxide, suspended particulate matter, automobile exhaust gases, and meteorological parameters are discussed in detail. A survey of air pollution sources in Osaka City is summarized.

09474

N. Y., Economic Commission for Asia and the Far East

AIR POLLUTION BY FUEL BURNING THERMAL POWER STATIONS. E/CN. 11/I&NR/Sub.1/L.39, 44p., Feb. 23, 1968. 28 refs.

The problem of atmospheric pollution, especially fuel burning thermal power stations, was discussed at the tenth session of the Sub-Committee on Electric Power. A questionnaire was circulated to the countries of the region operating large fuel burnign thermal power stations concerning the prevention or control measures that had been taken by each. Replies were received from Malaysia, Singapore, Hong Kong, Thailand, Korea, Philippines Pakistan and New Zealand. Other sources of contamination e.g. chemical industries, automobiles, and domestic heating or fires were discussed. It is estimated that 125.0 million tons of pollutants are emitted annually in the United States. The electric power industry contribution to this total is 15.7 million tons or 12.5 percent. However, the latter figure represents 0.8 percent of the total carbon monoxide, 45 percent of all sulphur oxides, 20 percent of a particulate matter, 30 percent of all nitrogen oxides and 5 percent of all other emissions. It is con cluded that measures designed for the abatement of air pollution involve large expenditures, consequently, a compromise between the expense involved and the acceptable degree of air quality is es sential.

10166

N. Y. Yanysheva

BASIC DATA FOR THE DETERMINATION OF SANITARY CLEARANCE ZONE WIDTHS AROUND PEAT BURNING ELECTRIC HEAT AND POWER STATIONS. Gigiena i Sanit., 24(9):6-10, 1959. 5 refs. Translated from Russian by B. S. Levine, U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 6, 299p., April 1961. CFSTI: TT 61-21982

A study was made to obtain data for the revision of the sanitary clearance zone regulation applicable to electric heat and power stations which used plat as fuel. The studies were conducted in the environs of four separately located electric power generating stations. The stations burned 50, 90, 200 and 250 tons of peat per hour; they were equipped with jalousie ash catchers and cyclone ash abaters which operated at 50-65% effectiveness, with the smoke stacks ranging between 30-60 m height. The study was limited to the estimation of pollution with dust and SO2. Samples were collected by the aspiration method in the path of the smoke plumes. Simultaneously studies were made of the amounts of ash and SO2 actually emitted into the atmosphere by the electric stations. From the results of these studies, the sanitary clearance zone was calculated for each power station.

10503

Tennessee Valley Authority, Chattanooga, Tennessee, Office of Power

COMPARISON OF COAL-FIRED AND NUCLEAR POWER PLANTS FOR THE TVA SYSTEM. 36p., June 1966

A detailed cost comparison of coal-fired and nuclear power plants (both the boiling water and pressurized water reactor types) for th TVA system is presented for actual bids submitted by commercial builders. Consideration is given to initial investment, interest, maintenance, geographic location, projected fuel costs, operation assurance by the vendor, capacity guarantees, and overcapacity capability. Design and operation of the nuclear plants are also discussed. Nuclear power plants of either type were superior to th coal-fired plant, and the boiling water reactor design was slightly superior to the pressurized water reactor design.

10998

Putnam, B. and M. Manderson

IRON PURITES FROM HIGH SULFUR COALS. Chem. Eng. Progr. 64(9):60-65, Sept. 1968.

The major sources of SO2 emission are coal fired power generation facilities, followed by other industrial facilities and space heating. It also appears that power plants will become increasingly important potential contributors of SO2 emissions. Therefore, reduction of emissions from coal fired power generation facilities is of principal concern. The National

Center for Air Pollution Control authorized two commercial firms to investigate the economics of utilizing iron pyrite (FeS_2) obtained from coal beneficiation, such as in sulfuric acid manufacture. The evaluation includes technical, marketing, and economic considerations and emphasizes the three major coal producing regions in the U. S. believed to have significant quantities of pyrite associated with the coal: central Pennsylvania, southern Illinois, and northeast Ohio.

11185

Coordinating Committee on the Economic Impact of Pollution Abatement, Washington, D. C.

SECONDARY IMPACT OF AIR POLLUTION ABATEMENT. (SECOND REPORT.) 10 p., Dec. 15, 1967. ((13)) refs.

The Working Committee's evaluation of the secondary impact of air pollution abatement is summarized. The Working Committee on the Secondary Impact is part of a larger effort to look at the econo mic impact of pollution abatement as directed by the President. It is inevitable that the imposition and enforcement of any regu lations designed to reduce air pollution from fuel combustion, es pecially sulfur oxide pollution, will have some adverse effect on on the areas from which the fuel now being used is obtained. In the case of oil, the impact would fall mainly on Venezuela, in the se of coal, it would fall on certain of our major coal producing centers. In both cases, the degree of hardship and disruption will depend greatly on the nature and timing of the regulations imposed. Regulatory policy which allows the use of higher sulfur fuels in installations and under conditions which are compatible with the basic abatement objective can greatly soften the adverse impact on the economics of the fuel producing areas. It can also significantly reduce the costs of abatement imposed on the fuel consuming industries. Of course, uniform restrictions on fuel content are easier to draw and enforce than more flexible rules, bu administrative convenience is a poor reason for seriously aggravating the hardships attendant on the adjustment process.

11242

M. C. Manderson

SULFUR OUTLOOK INTO THE EARLY 1970'S. Preprint, Arthur D. Little, Inc., Cambridge, Mass., ((28))p., 1968. (Presented at the 61st Annual Meeting, American Institute of Chemical Engineers, Symposium on Sulfur, Sulfuric Acid and the Future, Part I, Los Angeles, Calif., Dec. 1-5, 1968, Paper 5-A.)

In 1967, the United States consumed 9.3 million long tons of sulfur equivalent. Ninety percent of the total amount of sulfur consumed was in the form sulfuric acid. The major end uses of sulfuric acid were used in producing nitrogenous and phosphatic fertilizers. The Free World increase in sulfur consumption has been higher than that of the United States since 1950, 51% per year compared with 3.6% per year. Over the next seven years Free World consumption is expected to grow at 5% per year, from the 1967 level to 36 million long tons to 39 million long tons. About 5.5 million long tons of new sulfur capacity will emerge outside the United Sates over the next 2 1/2 years. Sulfur production in U. S. will grow from the 1967 level of 9.3 million long tons to 14.1 million long tons by 1970 and to 15.8 million long tons by 1975. The amounts of sulfur from lower cost sources will be adequate to meet U.S. needs by 1970, including net exports of one million tons per year. It is believed that sulfur prices will seek lower levels which are more in line with mimimum return requirements.

11266

Public Health Service, Washington, D.C., Div. of Air Pollution

REGULATION OF SULFUR OXIDE EMISSIONS FROM FEDERAL FACILITIES. Preprint, 39p., Nov. 1966.

The Department of Health, Education, and Welfare has recommended desirable air quality goals and objectives for sulfur dioxide that are consistent with those of involved local and State governments. Present sulfur dioxide pollution levels in New York, Philadelphia, and Chicago greatly exceed desirable air quality levels and will continue to worsen unless corrective steps are initiated immediately. The emission rate of sulfur oxides from combustion units of all Federal facilities or buildings in the New York Standard Consolidated Area should not exceed 0.35 pounds per million BTU calculated as sulfur dioxide. The emission rate of sulfur oxides from combustion units of all Federal facilities or buildings in the Chicago Standard Consolidated Area and the Philadelphia Standard Metropolitan Statistical Area should not exceed 0.65 pounds per million BTU. Desirable air quality levels of sulfur dioxide will not be achieved in the New York, Philadelphia or Chicago area only by sulfur restrictions on the fuels used by Federal facilities. It is essential that Federal facilities initiate fuel burning practices to reduce their contribution of sulfur oxide emissions for protection of the health and welfare of the people in these critical areas.

11283

Gray, Charles A.

FLASH ADSORPTION PROCESS FOR REMOVAL OF SULFUR DIOXIDE FROM STACK GASES. PLANNING PROPOSAL. FMC Corp., Princeton, N. J., Central Research Dept., 14p., June 10, 1966. 5 refs.

The flash adsorption process for SO2 removal from stack gases appears attractive both technically and economically. The operating costs of process are highly dependent on the values assigned to the by-product sulfuric acid. Assuming active calcinate at $20 per ton, the proposed process breaks even at an acid value of about $11 per ton (100% basis). This is significantly better than the existing processes. Both the cost and consumption of active calcinate are certain. By using different regeneration process, elemental sulfur may be obtained as a by-product rather than sulfuric acid. The proposed process will desulfurize flue gas at a gross operating cost of about $0.93 per ton of coal burned. The best competing process is estimated to operate for $1.55 per ton of coal. The capital required for the proposed process is about 75 percent of that required for the next best process. (Author's abstract)

11319

P.R. Lee

STATEMENT BEFORE THE RESEARCH AND TECHNICAL PROGRAMS SUBCOMITTEE OF THE COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES. Preprint, Dept. of Health, Education, and Welfare, Washington, D. C., 38p., Sept. 5, 1968.

The National Air Pollution Control Administration has underway a large-scale research and development program aimed at finding and demonstrating practical solutions to the problem of sulfur oxides pollution. Emphasis is placed principally on the development of technology applicable to fuel combustion sources. This program involves the combined efforts of more than 40 non Federal organization, including industrial firms and research institutions, and several agencies of the Federal Government. (Author's summary)

11383

Brantner, Heinz and Gerald Fischer

AIR POLLUTION PROBLEMS ASSOCIATED WITH THE ERECTION OF A THERMAL POWER PLANT. Staub (English translation), 28(4):13-15, April 1968. 8 refs. CFSTI: TT 68-50448/4

Air pollution problems associated with the running of an oil-fired power plant in Germany are discussed. The area under consideration is prone to inversions and calm winds, and the local populace were concerned about excessive SO2 pollution from the plant. The subject of stack height is discussed, but due to meteorological and economic reasons, a tall stack was not employed. Maximum SO2 levels are stated, and requiremednts for action are outlined for cases where the power plant might exceed these limits. Required actions included shutting the plant down, reducing output, switching to low-sulfur fuel oil, and installation of an SO2 control system.

11526

Public Health Service, Arlington, Va., National Air Pollution Control Administration

SULFUR OXIDES POLLUTION CONTROL. Federal Research and Development Planning and &rogramming 1968-1972. 112 p., April 1968. CFSTI: PB 180769

The sulfur oxide pollution problem is discussed. Sources of pollution, legislative history and congressional action, and future trends in sulfur dioxide pollution are discussed. The overall current federal research and development program for sulfur oxide control is summarized. Sections of the program include: flue gas treatment; stack meteorology; fuel desulfurization; fuel conversion; new combustion processes; industrial process control; fuel availability surveys; supporting instrumentation development; and program development, analysis, and evaluation.

11781

The Coordinating Committee on the Economic Impact of Pollution Abatement, Washington, D. C.

SECONDARY IMPACT OF AIR POLLUTION ABATEMENT. 10p., Dec. 15, 1967.

The imposition and enforcement of any regulations designed to reduce air pollution from fuel combustion--especially sulfur oxide pollution -- will have some adverse effect on the areas from which the fuel now being used is obtained. The degree of hardship and disruption will depend greatly on the nature and timing of the regulations imposed. In drawing these regulations, it is essential to keep the basic objective firmly in mind. This objective can be most simply stated as the reduction of the ground-level concentration of sulfur oxide emissions to a ratio compatible with the health and well-being of the communities affected. In particular, it should be stressed that sulfur content limitations for fuel are a means to an end and not the end itself. Regulatory policy which allows the use of higher sulfur fuels in installations and under conditions which are compatible with the basic abatement objective can greatly soften the adverse impact on the economies of the fuel producing areas. It is imperative that adequate -- but not excessive -- time be allowed to permit both suppliers and consumers of fuel to adjust to the new requirements. The importance of encouraging research and development in such areas as desulfurization methods, stack removal devices, and methods of assessing the ways in which all available techniques can most effectively and economically be integrated into a balanced abatement program is suggested by the considerations discussed. (Authors' conclusions, modified)

12031

J. S. M. Botterill

FACTORS BEHIND THE NATION'S FUEL AND POWER POLICY. Brit. Chem. Eng., 13(11):1567-1571, Nov. 1968. 5 ref.

The vital importance of fuel and power policy to industrial- social health underlies this examination of national fuel policy. The interrelationships of the various fuels are discussed. Coal's declining use presents a major social problem in many areas in the United Kingdom. The high capital cost of electricity generating capacity and of natural gas distribution is in large measure balanced by the increased convenience and availability of supply. Strategic considerations are involved in the importation of fuel oil. Nuclear energy must also be considered in an evaluation of the economy as it relates to fuel policy. Future demand will reflect the growth in the economy and the rising standard of living of the domestic consumer.

12461

Croke, E. J., J. E. Carson, D. F. Gatz, H. Moses, A. S. Kennedy, J. E. Norco, J. J. Roberts, K. G. Croke, J. B. Anderson, D. M. Nelson, J. E. Ash, R. P. Carter, D. Parsons, J. W. Lin, and R. J. Votruba

CHICAGO AIR POLLUTION SYSTEM MODEL. Argonne National Lab., Ill., Chicago Dept. of Air Pollution Control, Ill. and Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, PR-4, 266p., March 1969. 3 refs. CFSTI: ANL/ES-CC-004

The Chicago air pollution system model, a project oriented around the use of systems analysis to develop effective air pollution incident control strategies and long-range air quality control plans for urban areas, is described. The objectives of the project are as follows: the development of a computerized methodology for 12-24 hour advance prediction of ambient sulfur dioxide concentrations; the development of optimal air pollution control strategies; and the integration of air pollution control into the long range planning for urban area. Since the results of the project must be generally applicable on a national scale, emphasis is placed on the study and solution of air pollution problems which the Chicago area shares with other urban concentrations rather than on elements which are local and peculiar to Chicago alone. Meteorological data is used in a statistical air pollution forecasting system, as well as a source-oriented atmospheric dispersion model which realistically simulates plume dispersion. A computerized control system for a power plant network is presented, along with a natural gas supply and distribution system. The structure of an incident control strategy is discussed. Experimental studies which have been initiated include an aircraft sounding program designed to obtain vertical temperature, humidity, and sulfur dioxide profiles over the city; a tracer study program using sulfur hexafluoride; correlation of space heating emission patterns with meteorological conditions; and a series of emission control tests to determine the relationship between emissions, meteorological conditions, and air quality. The economics of air pollution control are discussed, and abatement strategies are considered. Projected studies for the near future are presented.

13049

Bush, R.L., Charles T. Holland, K.K. Humphreys, J.W. Leonard, Charles H. Sawyers, and E.B. Wilson

COAL UTILIZATION. Mining Engineering, 21(2):114-117, Feb. 1969.

Research efforts on sulfur removal from coal are primarily directed at reducing pyrite content. Generally, the coal is crushed to 48 to 200 mesh to liberate the pyrite grains which are removed electrostatically or magnetically. Research in the area of coal gasification and liquefaction is being carried out by the Office of Coal Research. A pilot plant is currently in operation to produce synthetic crude refinery feedstock and a high-ash char for power generation. The process consists of partially dissolving coal in a coal-derived solvent and separating the liquid extract from the residual fuels. The liquids are hydrogenated to produce the synthetic crude for gasoline production. The possibility of commercially attractive fluidized bed combustion techniques continues to improve through research. The fluidized bed principle consists of combustion of fuel particles in a highly-mobile, fluid-state inert bed through which fluidizing gases pass. The turbulent motion of the fluidized bed causes release and transfer of heat. This method of combustion reduces combustion emissions. The effect of air pollution legislation on the coal industry is reviewed.

13055

Netschert, Bruce C.

AIR POLLUTION AND ELECTRIC POWER. IEEE (Inst. Elec. Electron. Engrs.) Spectrum, 6(7):71-76, July 1969. 10 refs.

The various developments in air pollution abatement regarding economic justifications are discussed. One approach to reducing sulfur oxide pollution has been to set a standard for maximum sulfur content in the fuel that is burned. If the fuel user desires to continue burning the same type of fuel, he can meet this standard in a number of ways: by using a fuel that has a low sulfur content; by desulfurizing the fuel; or by blending high sulfur fuel with low-sulfur fuel. However, there is a larger supply of coal and oil with high sulfur content than with low sulfur content, and since the price is lower it finds more use. Other methods of abating air pollution are the use of natural gas, which is sulfur-free, the use of nuclear power, the desulfurization of stack gases, and employing a high stack. All of these methods have some shortcomings. The price of natural gas could rise if a great number of industrial plants began to use it in place of fossil fuels. Avoiding air pollution by the use of nuclear power could result in increased thermal pollution of water resources. Although stack gas desulfurization is still in the e experimental stage, it appears to be the most promising method, since large quantities of elemental sulfur and sulfur dioxide can be recovered.

14535

Diehl, E. K.

AIR POLLUTION RESEARCH IN GERMANY AND GREAT BRITAIN AS OBSERVED DURING OCTOBER 1967 VISITS. Bituminous Coal Research, Inc., Monroeville, Pa., 19p., Nov. 1967.

The highlights of a trip to West Germany and Great Britain in October 1967, to survey methods and investigations of sulfur dioxide control, are reported, including a summary of coal research activities. The average sulfur content of the coals abroad 1.5% in Germany and 2% in Britain - makes the control of SO2 emission less of a problem than in the United States. Regulations concerning SO2 are based upon ambient air quality, permitting the emitter several alternatives by which to conform. Current research in Germany on SO2 control is concentrated mainly on limestone or dolomite addition in a dry system, and on the development of active carbons and chars for the dry adsorption of SO2 from flue gases. Some sizable pilot plants are in operation or are being erected. All plants whose operation results in pollutant emissions must be licensed by the Ministry of Health and must demonstrate continuing compliance with control regulations. Pollution considerations have an affect on plant location, which in turn significantly affects plant costs. In Britain, smoke and particulate control over the past decade has done much to improve the air pollution situation; ambient concentrations of SO2 are slowly declining in spite of a steady increase in the total SO2 emitted from larger power plants. Tall, multiple-flue stacks are given credit for this changing situation. Consequently, SO2 control for the sake of clean air is not currently a major subject for research in Britain; rather, the prime goal of pilot scale studies on a variation of the alkalized-alumina process is the production of sulfur, with lowered SO2 emission considered a by-product. The target concentration of SO2 in ambient air is 0.35 ppm, considered acceptable by medical researchers. Investigations of the synergistic effects of SO2 and smoke are being emphasized. It seems apparent that future coal use will be on a 'controlled decline' and will be kept alive strictly on a national economy basis. A future power policy for Great Britain is being formulated, taking into consideration the discovery of natural gas in the North Sea. Some specific research activities of various private and governmental organizations in West Germany and Great Britain, and one in Holland, are briefly described.

14598

Theodore, F. W.

LOW SULFUR BOILER FUEL USING THE CONSOL CO2 ACCEPTOR PROCESS: A FEASIBILITY STUDY. Consolidation Coal Co., Library, Pa., Research Div., Contract 14-01-0001-415, Rept. 2, 78p., Nov. 1967. 17 refs. CFSTI: PB 176910

The use of dolomite (Consol CO2 Acceptor Process) may be applied to the production of low-sulfur char and gas in two ways: (1) as a sulfur acceptor in the simple devolatilization desulfurization of coal, or (2) as both a source of heat and as a sulfur acceptor in a combined desulfurization-partial gasification plant. In each case, either high-BTU pipeline gas (Option A) or high-purity hydrogen (Option B) can be produced. In Option B, hydrogen purification is based on cryogenic separation, which results in the production of a high-value fuel gas as a third product. This can be added to the boiler char to lower the sulfur level in the total boiler fuel; as an alternative, it can be used as clean reformer fuel in the context of a large coal desulfurization plant. Feasibility studies of the four applications indicate that (2), Option B is the most economically attractive process. It produces a low-sulfur boiler fuel at no increase in boiler fuel cost and two by-products: marketable quantities of elemental sulfur and low-cost, 95% pure hydrogen. Credit for hydrogen should more than cover total operating costs. If all fuel gas and char are burned together and credited at 18.50/MM BTU (1967 figures), the resulting cost of hydrogen is 24-250/MCF. The economics of this operation are particularly attractive if the process is considered as part of an integrated coal-to- gasoline/gas complex which can utilize the low-cost hydrogen. This process would not require the lengthy power plant shutdowns that are necessary for the installation of stack gas cleaning equipment.

17006

Commission of European Communities, Luxembourg (Belgium), General Management of Coal

COOPERATION BETWEEN C.E.C.A. AND THE U.S.A. (COOPERATION C.E.C.A.- U.S.A.). Document No. 4894/1/67 f, 6p., Sept. 29, 1967. Translated from French. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 8p.

The exchange of information, collaboration, community studies on subjects about which the United States could be in-formed or the results of which could be communicated to it against renumeration or payments, and American research about which the community would desire to have more information than in the past are covered. A summary of the various documents tendered by the American delegation (U. S. Bureau of Mines, Bituminous Coal Research Association, and the U. S. Office of Coal Research) and various proposals of the French, Belgian, and German delegations is compiled. Exchange of information includes the following topics: utilization of low-temperature tars and pitches; improvement of small furnaces operating on grain fuel; transport of coal in ducts; and improvement of the new firebricks. Collaboration includes the following topics: mechanical preparation of coal; utilization of fly-ash and washing slate and other mine residues; combustion methods; and fundamental research into chemistry and physics of coal and coke. Community studies contain the following topics: oxidation of coal and its agglomerates; coking; production of soluble oxidized coal; production of active coal; combustion methods; and capturing methane. American research includes the following topics: preparation of coal; carbonization at low temperature; liquefaction and gasification of coals; carbochemistry; and direct transformation of energy.

17321

Croke, Edward J. and Samuel G. Booras

DESIGN OF AN AIR POLLUTION INCIDENT CONTROL PLAN. J. Air Pollution Control Assoc., 20(3):129-138, March 1970. 7 refs.

To accomplish the transition from a comprehensive but somewhat theoretical concept of air pollution incident control to an array of practical contingency plans, a series of air pollution control tests were initiated in Chicago. The initial effort to develop and field test a prototype operational air pollution incident control strategy was focused on the control of sulfur dioxide emissions from coal and oil burning industrial sources, large commercial and residential structures, and urban power plants. In a series of fixed response emission control tests, participating fuel users alternated between high sulfur fuels and natural gas. Results showed that, in Chicago, operational control of dual fuel power plants is feasible and that switching from coal to oil to natural gas on short notice does not impose a serious operational penalty on most dual fuel users. Fuel consumption records maintained by the participants provided a data base for the refinement of Chicago's emission inventory and the planning of future tests. In a second test series, emission control operations were initiated on the basis of meterological weather forecasts. Communication requirements and the response capability of participating users were noted. The third emission control test was designed as an incident control war game and included a more realistic simulation of the command and control structure, organization, communications, logistical functions, technological aids, and decision processes involved in implementing an incident control program. The control strategies developed were imposed on fuel users and emergency surveillance and enforcement procedures were put into effect. The war game helped to identify deficiencies in the incident control program.

17472

Duemmler, Friedrich

THE ANTI-AIR POLLUTION ACTIVITIES OF THE TECHNISCHE UEBERWACHUNGS-VEREIN. (Die Technischen Ueberwachungs-Vereine im Dienste des Immissionsschutzes). Text in German. Tech. Ueberwach (Duesseldorf), 10(10):339-345, Oct. 1970.

One of the most important tasks of the Technische Ueberwachungs-Verein (TUV) is to measure dust emissions by steam plants. By checking the performance of new measuring units and determining whether they fulfill the manufacturer's specifications. Measurements by the TUV taken in 1967 on steam boilers with capacities of up to 25 t/h showed that plants without dust collectors emitted on the average 560 mg dust/cu m; those with dust collectors, 170 mg/cu m. For plants with more than 100 Gcal/h, the authorities require the installation of automatic measuring devices for dust and sulfur dioxide. In this connection, TUV checks the available units for suitability and calibrates each individual unit. For dust measurements, photometric units were suitable; for SO2 measurements, infrared absorbers and electroconductivity analyzers were selected. In addition to these activities, TUV is presently engaged with fluorine, hydrocarbon, hydrogen sulfide, sulfur trioxide, carbon monoxide, hydrogen chloride, lead, and zinc oxide measurements. In the years 1965-1966, TUV conducted extensive studies of CO and CH content of automobile exhausts in the idling stage. Infrared absorbers were used for the measurements. Ten percent of the vehicles with four-stroke engines emitted more than 8% CO in the idle; but 45% of the vehicles emitted less than 4.5%. Beginning with October 1, 1970, newly registered automobiles with Otto engines may not emit more than 25 g CO and 1,5 g CH per 100 g fuel consumption. TUV will check the new automobiles for compliance with this law. Finally, odor and noise measurements also belong to the activities of the TUV.

17473

Katin, Arno

UNIFORM PRACTICE FOR THE ENTIRE FEDERAL REPUBLIC (OF GERMANY) FOR MONITORING EMISSIONS FROM PLANTS COVERED BY ARTICLE 16 OF THE INDUSTRIAL REGULATIONS. (Bundeseinheitliche Praxis bei der Ueberwachung der Emissionen aus Anlagen nach Paragraph 16 der Gewerbeordnung). Text in German. Tech. Ueberwach (Duesseldorf), 10(6):193-196, June 1969. 1 ref.

Article 16 of the industrial regulations primarily covers power plants, the emissions from which can not yet be limited, due to a lack of suitable cleaning methods. These plants, however, have been required to find the proper stack height so that the gaseous pollutants are sufficiently dispersed. In 1964, all plants emitting more that 25 kg/h of dust or more than 200 k g SO2/h had to install suitable continuously recording emission measuring units. 'Suitable' was defined as being capable of three months of continuous operation without failure. This meant that all dust measuring units were to be subjected to endurance testing which required complex laboratory facilities. Thus, three well equipped laboratories were used for the testing for the entire Federal Republic. Furthermore, it was decided to require calibration of each measuring unit after it had been installed into the plant. Such calibrations were thought necessary to eliminate errors arising under locally different conditions. These costly calibrations made it necessary to limit installation of monitoring units for the time being to plants with a heat capacity of 100 Gcal/h and more.

18121

High, M. Dean and W. H. Megonnell

POLLUTION CONTROL: FEDERAL LEADERSHIP. Mech. Eng., 91(2):20-23, Feb. 1969.

Executive Order No. 11282, issued in 1966, requires that all Federal agencies take steps to prevent and control air pollution from their installations. Sulfur oxide emission rates have been established for all Federal facilities in three densely populated cities: New York, Philadelphia, and Chicago. The emission rate of SOx from combustion units of all federal facilities in these metropolitan areas are 0.35 and 0.65 lb/mill Btu calculated as SO2.

18220

Pollack, Lawrence W.

LEGAL BOUNDARIES OF AIR POLLUTION CONTROL--STATE AND LOCAL LEGISLATIVE PURPOSE AND TECHNIQUES. Law and Contemporary Problem 33(2):331-357, Spring 1968. 150 refs.

The legal experiences encountered in the development of the various state and local techniques, so that future legislative efforts can be judged and guided accordingly are reviewed. Because recent New York City legislation employs most of the available legislative techniques, it is used throughout this article as an example of source control legislation. The ordinance provisions recommended by the Public Health Service are used as a model of 'Air Resource Management' legislation. Experience has shown that most carefully drafted public health related control techniques are within the legal boundaries established by the U. S. Constitution.

18223

Rein, Barry D.

OBTAINING BOILER FUEL GAS TO REDUCE AIR POLLUTION: THE POLICY OF THE FEDERAL POWER COMMISSION. Law and Contemporary Problems, 33(2):399-420, Spring 1968. 67 refs.

Generation of electrical power by fossil fuels invariably produces pollutants; the particular pollutants produced and their effects vary with the type of fuel, the location of the plant, the type of generating unit, the existence of pollution control equipment, and the scheduling of particular fuels in multi-fuel plants. This article deals with an aspect of utilities regulation of particular importance: The jurisdiction of the Federal Power Commission (FPC) over the use by steam-electric generatig utilities of natural gas for boiler fuel, for the purpose of reducing air pollution produced by burning alternative fuels.

19062

Spaite, Paul W.

FEDERAL AIR POLLUTION PROGRAM: READY TO FINANCE MORE OUTSIDE HELP. Chem. Eng., vol. 75:170-172, Jan. 15, 1968. (Presented at the Metropolitan Engineering Council on Air Resources Meeting, New York, Oct. 23-24, 1967.)

The trend in the federal research and development program for controlling sulfur pollution is toward spending more on contracts outside the government. Research and development funds managed by the National Center for Air Pollution Control are shown in tabular form. The figures represent the federal expenditures oriented directly for sulfur oxides control. A study was conducted to determine the processes worthy of support. Three approaches were selected for the first-generation large-scale study: limestone or dolomite injection, including dry processes, and injection coupled with water scrubbers; alkalized-alumina sorption; and processes that would treat pyrite-coal mixtures derived from deep cleaning of coal to produce heat, sulfur, and sulfuric acid. The program for developing new processes is aimed at providing second-generation processes for removing sulfur dioxide from flue gases arising from the combustion of fossil fuels. Two types of contracts are being negotiated. One will be devoted to through, broad surveys of available technology in nine areas: aqueous solution, dry metal oxide sorption, direct reduction to sulfur, inorganic liquids and solids, organic liquids and solids, catalytic oxidation, and physical separation. The second contract calls for unsolicited proposals. To encourage more extensive control of such sources as primary smelters, pulp and paper mills, sulfuric acid plants, and coke plants, a series of studies on cooperative research and development are planned.

20698

Dickinson, R.

MEASUREMENTS OF DOMESTIC SMOKE EMISSION AND THEIR APPLICATION TO CLEAN AIR LEGISLATION. J. Inst. Fuel, vol. 43:75-81, March 1970. 15 refs.

To assist in the implementation of a clean air policy, a laboratory investigation was conducted to determine the weight of smoke emitted from domestic solid fuels and appliances. A small electrostatic precipitator was used to determine the weight. A representative range of open-fire fuels including bituminous coals, low volatile steam coals, anthracite, manufactured fuels, and wood and peat fuels were compared by a standard series of tests. Supplementary investigations were made to find the effects of the method of ignition, size grading, and refuelling procedure. Measurements were also made of the emissions from two authorized fuels on a small boiler and from a limited number of experimental smoke-reducing appliances. These investigations have enabled the British Standards Institution to draw up a standard for the authorization of manufactured smokeless fuels and to recommend the exemption of smoke-reducing appliances and to recommend these to the Ministry of Housing and Local Government. It was recommended that the authorization level should ensure a smoke reduction of 80% compared with bituminous coal; a limiting level of 0.9% at a burning rate of 2 lb/hr was considered appropriate.

21431

Gonschorek, Dietmar and Gerhard F. Mueller

FEASIBILITIES AND LIMITS OF FINANCIAL PENALTIES FOR AIR POLLUTERS. (Moeglichkeiten und Grenzen oekonomischer Regelungen zur Reinhaltung der Luft). Text in German. Chem. Tech. (Berlin), 22(3):158-161, March 1970.

In an industrial center, the effect of financial penalties for air polluters was studied. Limit concentrations were worked out according to the individual meteorological and topographical conditions. High penalties were collected for exceeding these limits which were used for air pollution studies. After two years, it was shown that not all excessive emissions could be limited this way. Power plants frequently were unable to cope with their emissions within reasonable expenditures. Completely new plants are required in order to reduce the emissions to the required limit. For the chemical industry, the penalties were too low to be incentive. But between these two extreme cases, there were those which found it less expensive to install control facilities than pay the penalties.

24033

Damon, W. A.

THE CONTROL OF NOXIOUS GASES AND FUMES DISCHARGED FROM INDUSTRIAL UNDERTAKINGS. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 103-130. 26 refs. (Nov. 6-14.)

The greatest contribution to air pollution arises from the combustion of fuel for domestic and industrial purposes and from motor traffic. Its damaging effects include injury to plants, deterioration of property, and possible or proven hazards to the health of humans and animals. British air pollution legislation is embodied mainly in three Acts of Parliament: the Alkali etc. Works Regulation Acts, first enacted in 1863; the Public Health Acts, 1936; and the Clean Air Act, 1956. Evolution of the chemical industry has caused a variety of changed and new pollutants. Fluorine compounds can be washed in alkaline solutions, followed by electrical precipitation. The escape of SO2 from the exits of sulfuric acid plants depend on the efficiency with which the the process is conducted. In four stage contact plants burning brimstone, recourse to scrubbing the exit gas with either soda or ammonia may be necessary. Power stations remove SO2 from waste fuel gases by scrubbing with slightly alkaline water. Sulfur dioxide arising from the roasting of copper as in the production of iron oxides is normally absorbed by passage through towers packed with limestone. Hydrogen chloride may be recovered at a useful strength by arranging a counter current series of absorbers. Hydrogen sulfide may be scrubbed with caustic soda to produce sodium sulfide; it may be absorbed by passage through hydrated iron oxide which can be regenerated to produce spent oxide containing up to 50% sulfur; or it can be stripped out by means of a solvent and regenerated in concentrated form for treatment in a Claus Kiln. Gases containing chlorine may be scrubbed with an alkaline solution or by contact with milk of lime; passage through a tower packed with scrap iron is also effective. Nitrogen peroxide may be recovered in the form of nitric acid by water washing; but for every three molecules of nitrogen peroxide thus absorbed there is evolution of one molecule of nitric oxide which must be reoxidized to nitrogen peroxide.

24214

Public Nuisance Control Committee (Japan)

BASIC POLICY REGARDING THE ESTABLISHMENT OF PUBLIC NUISANCE CONTROL PROGRAM FOR THE KANAGAWA AREA. (Kanagawa chiiki ni kakawaru koga boshikeikaku sakutei no kihon hoshin. An). Text in Japanese. Yosui to Haisui (J. Water Waste), 12(9):768-776, Sept. 1, 1970.

A control program to be effective in the area East of Sagami River within Kanagawa Prefecture is presented. This area serves as the mainstay of the Japanese economy, industries such as electric power, steel, petroleum, chemicals and heavy automobile traffic have contributed to the chronic pollution problems. Air pollution in the Taishi and Tajima areas and water pollution in Tama, Tsurumi, and Katabira Rivers as well as Tokyo Bay are extremely severe. The pollutant levels are to be lowered to within the tabulated limits by 1980. There are many necessary control measures, but the following are especially emphasized in view of the national planning priorities. They are the control measures against stationary air pollution sources in Kawasaki, especially purification of coastal waters and rivers and streams, control of nuisances accompanying automobile traffic, and treatment measures for metropolitan and industrial wastes. In addition, surveillance and measurement systems as well as cooperation with the neighboring prefectures are indispensable. Detailed tables are given on the target maximum allowable concentrations of sulfur oxides, suspended particulates, and carbon monoxide in air as well as cyanides, alkyl mercury, organic phosphorus, cadmium, lead, chromium, arsenic, mercury in general, and pH, BOD, SS, DO and coliform bacteria values for water pollution. The maximum allowable noise levels for daytime, morning and evening are also listed.

25688

Resources Research, Inc., Washington, D. C.

PROPOSED IMPLEMENTATION PLAN FOR THE CONTROL OF PARTICULATES AND SULFUR OXIDES FOR THE STATE OF OHIO PORTION OF THE METROPOLITAN CINCINNATI INTERSTATE AIR QUALITY CONTROL REGION. NAPCA Contract CPA 70-29, 238p., Sept. 1970. NTIS: PB 195758

The Metropolitan Cincinnati Interstate Air Quality Control Region (MCIAQCR), designated in May 1969, comprises approximately 3000 square miles of land area located in the extreme southwestern portion of Ohio and the adjacent states of Indiana and Kentucky. The proposed regional control strategy for particulates consists of emission standards covering three general categories of emissions: industrial process, fuel combustion, and solid waste disposal. The proposed control strategy for sulfur oxides consists of those emission standards already in effect in Cincinnati: the emission categories considered by these standards are industrial process and fuel combustion. When adopted and enforced, these strategies shoul lead to acceptable levels of both suspended particulate and sulfur dioxide as defined by regional Air Quality Standards. Legally enforceable control regulations based on the emission standards are presented. In Ohio, the regulations will be implemented primarily through a permit and source surveillance system. Legal and administrative deficiencies hindering enforcement of the control plan in Ohio are pointed out, and remedial measures suggested. Als reviewed are the projected regional air quality monitoring network and procedures to be used to control sources during emergency episodes.

26157

Burns, Leland S.

URBAN PLANNING ASPECTS OF AIR POLLUTION ABATEMENT. In: Project Clean Air. California Univ., Berkeley Task Force No. 3, Section 7, 17p., Sept. 1, 1970. 46 refs.

People from all parts of the urban scene who are concerned with the increased problems of coordination have been increasingly looking to the planners for the abatement of many problems, including air pollution. Regional applications of site selection, wind effects, and air flow patterns have been considered in the architectural and planning processes. Environmental planners are considering various density levels for an urban area and what these levels impl about pollution. The most developed are most documented air resource management program exists in the Chicago metropolitan area while the Northeastern Illinois Planning Commission has listed the sources of pollution as space heating, power generation, waste disposal, industrial processing, and transportation. Air zoning is the main toll of the Chicago program. Recommendations for physical planning research include regional modeling which would be both a monitoring and evaluative device; indicators; air basin capacity; effect of city size and population density; and the habitat. Proposals for policy planning research include the search for effective institutional frameworks, monitoring and control functions, jurisdiction, levels of acdeptable air pollution, and points of intervention.

M. SOCIAL ASPECTS

00336

G. Ozolins and R. Smith

A RAPID SURVEY TECHNIQUE FOR ESTIMATING COMMUNITY AIR POLLUTION EMISSIONS. Public Health Service, Cincinnati, Ohio, Division of Air Pollution. Oct. 1966. 83 pp. (Presented at the 59th Annual Meeting of the Air Pollution Control Assoc., San Francisco, Calif., June 20-24, 1966, Paper No. 66-11.)

A technique has been developed for surveying pollutant emissions within a community or metropolitan area in 3 to 6 man-weeks. The methods for conducting such a survey are described in this paper. An important feature of this technique is the concept of reporting zones. The quantities of pollutants released can be assessed not only for the total community but also for different subdivisions of the area. The results are emission maps of a community depicting emission of pollutants in quantities per unit area. Seasonal variations in pollutant concentrations are considered, and emission rates of pollutants can be calculated for specified times of the year. The four major source categories considered are combustion of fuels in stationary and in mobile sources, combustion of refuse material, and industrial process losses. Each category is considered in detail relative to sources of information, seasonal variation in emissions, methods for estimating pollutant emissions by areas, and use of emission factors. Results obtained by application of this technique in two metropolitan areas are summarized. (Author)

01220

THE POTENTIAL MARKET FOR FAR WESTERN COAL AND LIGNITE (VOLUME I). Nathan (Robert R.) Associates, Inc., Washington, D. C. (487) Dec. 27, 1965. CFSTI: PB 169 315

The four categories covered in this study are summarized as follows: 1. Analysis of present supply and demand for coal and lignite and competitive fuels and sources of energy. 2. Analysis of all the significant elements affecting the competivive position of Western coals and lignite. 3. Analysis and projection of the potential market for Western coal and lignite in 1980 by major producing area, market area and end use. 4. Estimates of additional market potential for Western coals and lignite on the assumption of favorable developments or actions. The far Western states, Washington, Oregon, California, Nevada, Arizona, New Mexico, Utah, Colorado, Idaho, Wyoming, and Montana are discussed in relation to the above four categories.

01221

THE POTENTIAL MARKET FOR FAR WESTERN COAL AND LIGNITE (VOLUME II - APPENDICES). Nathan (Robert R.) Associates, Inc., Washington, D. C. Dec. 27, 1965. 360 pp. CFSTI: PB 169 316

The four categories covered in this study are summarized as follows: 1. Analysis of present supply and demand for coal and lignite and competitive fuels and sources of energy. 2. Analysis of all the significant elements affecting the competitive position of Western coals and lignite. 3. Analysis and projection of the potential market for midwestern coal and lignite in 1980 by major producing area, market area and end use. 4. Estimates of additional market potential for midwestern coals and lignite on the assumption of favorable developments or action. The midwestern states, North Dakota, South Dakota, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Nebraska, Kansas, Oklahoma, Texas and Alaska are discussed in relation to above four categories.

01567

H. Berge

EMISSION CONTROL - A SUPRA-NATIONAL CONCERN IN OUR TECHNICAL AGE. (Immissionsschutz, Eine Uberstaatiche Gemeinschaftsaufgabe in Unserem Technischen Zeitalter.) Z. Sozialoekonomie, No. (614.7)1-8, 1966.

Local SO2 warnings; guide lines; and limit values are critically discussed with emphasis on the situation in Northern Rhine-Westphalia. The need for independent evaluations and supranational regulations are stressed for the west European community. The economic and sociological as well as the biological aspects of the problem are discussed. The need for continuous measurements is underscored.

08072

Garvey, James R.

EFFECTS OF PUBLIC INTEREST IN THE ENVIRONMENT ON THE COAL INDUSTRY. Preprint, Bituminous Coal Research, Inc., Monroeville, Pa., 14 p., (1966) Presented at the Annual Meeting, Industrial Hygiene Foundation of America, Inc., Pittsburgh, Pa., Oct. 18, 1966

A review of the pollution situation so far as the coal industry is concerned, and a summary of the state of the art of abatement, primarily of air pollution resulting from the combustion of bituminous coal, but also to a somewhat lesser extent, the abatement of water pollution and the reclamation of land involved in the mining of coal is presented. The state of the art of control of pollutants from the combustion of coal is moving forward on all fronts. The technology for control of smoke and fly ash is already available in an advanced state, and additional progress is being made. However, in the control of sulfur oxides, much still remained to be done, despite an expanded research effort by industry and others. Those control processes which are most advanced in technical feasibility are still at the present state of development far too expensive to install and operate, especially in light of the lack of knowledge regarding the degree of control which is necessary to protect human health. But progress is being and will continue to be made, and as the work passes through the large pilot state of development, opportunities will be available for improvements in the technology which will make them economically as well as technically feasible. The mining and preparation of coal for shipment to market also is the cause of pollution, including air, water, and land disturbance. Air pollution results from the spontaneous ignition and subsequent combustion of the refuse discarded in the cleaning of coal for market. The technology for prevention of spontaneous combustion in new refuse piles has been developed, and by means of careful selection of site and compaction, this source of air pollution can be eliminated in the future.

22636

Nowlan, J. P.

THE POLLUTION ALTERNATIVES - ENVIRONMENTAL CONTROL OR A LOST CIVILIZATION. Can. Mining Met. Bull. (Montreal), 63(701):974-978 Sept. 1970.

The rate of growth and hence the concentration of industry has been accompanied by increasing concentrations of population and by a tremendous upsurge in the output of thermal energy. One of the reasons why this surge in pollution was largely unforeseen is the dominance of specialists in our complex economy without regard to consequences on the total environment. A fundamental problem is ignorance we do not know the optimum ratio between use and conservation to maintain or enhance the desirable features of our environment. Most of our pollution problems are due to concentrations of humans and of industry in certain areas to a point where the natural forces of waste control are no longer effective. Overcrowding of any species leads to degeneration of individuals and behavior aberrations. Research should be conducted into plasma conversion of garbage into its atomic elements, and growth of oxygen-producing algae should be encouraged to utilize these plants at maturity for their protein content. The energy balance in lakes needs to be studied much more intensively than has been done in the past. Tidal power is mentioned as an energy alternative to combustion and atomic power. Pollution and the mining environment are discussed, and the need for more publication as the one recently published outlining development and rehabilitation methods for open-pit mines is urged.

25143

Higginson, K.

THE PROBLEM OF AIR POLLUTION IN HONG KONG. Preprint, International Union of Air Pollution Prevention Associations, 10p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper AD-17E.)

The Hong Kong air pollution problems date back only some 25 years to the period when World War 2 ended. At that time when the Colony had largely to be rebuilt, and when use of fuels was comparatively low, it would have been possible to have designed an urban community which was free of the air pollution which now poses a serious problem. The principal causes of air pollution in Hong Kong are explained, and an attempt is made to show the possibl escape routes, and the new problems which are associated with those routes. Air pollution problems in Hong Kong are aggravated by the position of the Kai Tai Airport near the city. Poorly maintained diesel engines are another problem. The conclusions are that unles clean fuels can be made available in very large quantities to suppl the Far East, then it is essential to provide dry absorption processes at the power generating stations. These processes must occupy a limited ground area, and must be capable of operating without either a large consumption of fresh water, or the production of a liquid effluent. (Author abstract)

25188

Land, George W.

THE CHANGING PATTERNS OF FOSSIL FUEL EMISSIONS IN THE UNITED STATES. Preprint, International Union of Air Pollution Preventio Associations, 26p., 1970. 22 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-12G.)

During the past fifty years, the use of fossil fuel energy in the U. S. has increased 3.5 times. This increase and the changing pattern of the three sources of fossil fuel energy--coal, petroleum, and natural gas--has had much to do with the nature of air pollution in our cities. In spite of the projected rapid growth in the use of coal between now and the turn of the century and the publicity coal has received as a cause of worsening air pollution, the fact remains that the amount of coal used in the U. S. in 1968 was approximately the same as that in 1920, whereas natural gas use has increased twenty-five-fold, and petroleum use nine-fold in the same period of time. As a result, total emissions of three of the principal classes of gaseous emissions produced by fossil fuel burning, sulfur oxides, nitrogen oxides, and hydrocarbon, have increased. SOx emissions have increased approximately 30%, NOx 237%, and hydrocarbons 810%. All of these increased emissions resulted from the increased use of petroleum products and natural gas. The history of ambient levels of the three pollutants is not so easy to determine. Available data indicate SO2 ambient levels were falling, at least in those major metropolitan areas that depended primarily on coal as energy for stationary emission sources, even before the recent enactment of fuel sulfur restrictions in some major metropolitan areas. This was the result of the shift from coal for space heating and industrial plants, which are relatively low level emission sources. Long time span data on ambient levels of NOx and hydrocarbons are not available, but since the increase in these emissions comes primarily from low elevation emitters, the ambient levels of these contaminants are undoubtedly on the rise. The increasing incidence of the photochemical smogs in all of our major metropolitan areas bears witness to this increase. (Author abstract)

25193

Friedlander, Gordon D.

POWER, POLLUTION, AND THE IMPERILED ENVIRONMENT. I. IEEE (Inst. Elec. Electron. Engrs.) Spectrum, 7(11):40-50, Nov. 1970. 7 refs.

This first article in a series discusses aspects of the conflict between increasing demand for electrical power and the environmenta effects fossil-fuel and nuclear power plants. It is pointed out that even many of the air pollution control measures in use or under study require significant amounts of electricity and thus intensify the problem. Some of these are electrostatic precipitators for particulate collection, electric furnaces as a substitute for open hearth furnaces, and numerous possible mass transport systems and alternatives to the internal combustion engine. Major new construction usually assumes the availability of adequate electricity for its occupants, despite the absence of any advance planning. The solid waste disposal and thermal pollution problems of nuclear power, as an alternative to fossil fuels, are discussed, and a series of conflicting expert opinions quoted regarding the degree of hazard to public safety represented by nuclear plant operations, radioactive waste, and accident potential. Siting factors for fossil-fuel plants should include nearness to load centers, meteorological studies, probable temperature effects in receiving bodies of water, and ample provisions for public consideration and acceptance. Two methods of sulfur oxides control are noted as well as possible uses for waste heat and the long-term possibility of pollution-free power from geothermal steam fields.

N. GENERAL

00164

STATISTICS ON PARTICULATE CONTAMINANTS - SAN DIEGO COUNTY AIR POLLUTION CONTROL DISTRICT (FIRST QUARTER 1966). San Diego Dept. of Public Health, Calif. Mar. 1966. 7 pp.

First Quarter 1966 Statistics on Particulate Contaminants San Diego County Air Pollution Control District are presented. Data are included on weight concentrations from high volume filter samples, soiling indexes, and hourly averages of gaseous contaminants.

01063

L. Silverman

ENGINEERING CAPABILITIES IN ENVIRONMENTAL CONTROL. Arch. Environ. Health Vol. 12:120-128, Jan. 1966. (Presented at the Second American Medical Association Congress on Environmental Health Problems, Chicago, Ill., Apr. 26-27, 1965.)

The need for early recognition of engineering capabilities in environmental control by those concerned with the solution of environmental health problems is stressed. Engineering alone, in some instances, can provide satisfactory solutions to certain problems. In most cases, however, consideration of biological and socioeconomic factors is essential. The importance of evaluating problems at the source and early concept or design phases has been stressed. Effective communication on how engineering techniques can be best utilized is an essential need, and imporovement in dissemination of such knowledge deserves more attention in practice. A plea is made for integrating engineering capabilities in environmental control with the AMA environmental health effort to produce high level coordination and attack on problems of mutual interest. What is recommedned is for AMA to work with a permanent environmental health engineering committee established in the Engineer's Joint Council. Communication at both the national and international level in environmental health is needed to create some kind of federated society mechanism for specialty groups.

02632

Manz, O. E.

UTILIZATION OF LIGNITE FLY ASH. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines-North Dakota Univ. Symposium, Bismarck, Apr. 29-30, 1965). (Information Circular No. 304). p.66-78, 1966.

The previous limited work on lignite fly ash is reviewed. Current work at the University of North Dakota is reported. The potential of utilization is discussed. Applications in concrete are emphasized.

03344

F. E. Gartrell.

STATEMENT BY F.E. GARTRELL FOR HOUSE SUBCOMMITTEE ON SCIENCE, RESEARCH AND DEVELOPMENT. Tennessee Valley Authority, Norris, Division of Health and Safety.

A review of TVA experience in air pollution control, more specifically from large coal-fired power plants is presented. The principal elements of the TVA study program are (1) monitoring of SO2 concentrations in the vicinity of each plant, (2) collection and analysis of on-site meteorological data, (3) biological studies to determine effects of plant emissions on vegetation in special experimental gardens and in surrounding areas, (4) full-scale studies of stack gas dispersion, (5) investigations of possible means for reducing emissions through modification of plant operations during periods when meteorological conditions are unfavorable for dispersion, and (6) research on processes for removal of SO2 from stack gases.

04212

S. Abe

THE PRESENT STATUS OF AIR POLLUTION. Clean Air Heat Management (Tokyo) 15, (7-8) 7-18, Aug. 1966. Jap.

The present status of air pollution in Japan is given naming the kinds of contaminants and their origin, factors affecting contamination density, and various types of smog. The types of contaminants are: 1) minute particles (less than 1 micron in size) such as found in soot, carbon, ashes, dust; 2) coarse particles (greater than 1 micron in size), as found in dust, ashes, and minerals; 3) reactive substances found in mist, fog, and vapor such as SO2, SO3, H2S, CO2, CO, NO2, N2O3, O3, aldehydes, HC1, NH3, HF, Pb, Hg, Cd, As, Be and 3, 4-benzpyrene. The contaminants originate from factories, chemical plants, power stations, domestic heating, public baths, hotels, laundries, dry cleaning establishments, hospitals, schools, and public buildings. Also discussed are the human factors affecting air pollution such as public awareness and interest, seasonal, weekly, and daily changes in heating and cooking. Meteorological aspects are covered such as wind direction and velocity, turbulence, temperature, rain and snow. The types of smog found in New York, London, Los Angeles, Pittsburgh, and Yokkaichi are described. Graphs and tables list symptoms and diseases affecting plants and humans and give the density of dust particles and SO2 in the main cities of Japan. Data on the sulfur content of various oils produced by Japanese refineries and on the number of Japanese automobiles produced is included for information on emission sources of pollutants.

04432

J. W. Leonard, C. R. McFladden, P. G. Meikle, L. C. Mih, and H. E. Shafer, Jr.

COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 2: OHIO COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS. West Virginia Univ., Morgantown, School of Mines. (Coal Research and Development Rept. No. 8.) Feb. 1965. 110 pp. CFSTI, PB 168111

The extent, quality, and probable uses of potentially valuable minerals located above, in, and below significant coal seams are identified. Details are included on the location of nearby mineral markets and related coal-mining activity. The aim was to assist development of multi-product mining and processing.

05194

E. E. Drucker

ELECTRICAL POWER: ITS GENERATION, DISTRIBUTION AND STORAGE IN 1985. (In: Appendix to Science and Technology in the 1985 Era.) Syracuse Univ. Research Corp., N.Y. May 1964. pp. 274-9. CFSTI, DDC: 613526

Presently electrical power in the United States is virtually all produced by large central stations. By 1985, the installed capacity will have increased more than threefold to supply a population of 1/5 billion people. Hydroelectric generation of electricity will increase in quantity but diminish in its proportion to the total. Nuclear (fission) fueled power plants will experience considerable improvement in design but only a gradual growth in the next two decades for economic reasons. Magnetohydrodynamic power generators will be barely beyond the prototype stage in 1985 since both the suitable nozzle materials and schemes for raising the plasma conductivity which are necessary for this device will have been found only a few years earlier. Other means of power generation will have no significance in central power station application with the exception of auxiliary diesel or as turbine units to provide peak load capacity. The economy of power plants favors larger and larger central stations. As much as possible these plants will be located near demand centers but suitable sites will become progressively more scarce. These plants will be connected by a national and possibly an international distribution network. It is therefore projected that there will be a high increase in the number and length of transmission lines. Chemical fuel cells of several types will have been developed for a limited number of special applications where a noise-and vibration-free primary source of electricity is required. The use of thermoelectric and thermionic generators will be limited to a relatively small number of special applications where the basic energy form will be solar or radioactive isotope decay. The use of solar or photovoltaic cells will also be advantageous only for a few isolated applications.

06133

Stern, A. C.

THE CHANGING PATTERN OF AIR POLLUTION IN THE UNITED STATES. Am. Ind. Hyg. Assoc. J. 28(2), 161-5 (Apr. 1967). (Presented at the Joint Session of the Annual Meeting, American Industrial Hygiene Association and the American Conference of Governmental Industrial Hygienists, Pittsburgh, Pa., May 16-20, 1966.)

In the past, our principal concern has been with particulate emission--smoke, fly ash, cinders, and dust. Nationwide, our regulatory and abatement practices reflect this early preoccupation. The gaseous emissions and the gaseous products resulting from atmospheric photochemical reactions are a growing concern. This is reflected, for example, in our present preoccupation with the automobile. Although interest in gaseous and particulate emissions will continue i n the future, more attention will be paid to the particulate products resulting from atmospheric photochemical reactions. This will come from a recognition that not until the visible haze is lifted from our cities will they be truly livable. (Author's abstract)

07431

J. Pursglove, Jr.

FLY ASH IN 1980. Coal Age, 72(8):84-85,Aug. 1967. (Adapted from the author's remarks at the Fly Ash Utilization Symposium, Pittsburgh, Pa., Mar. 14, 1968.

By 1980, it is estimated that 45 million tons of fly ash will be produced by the electric utility industry. A wealth of raw materials are chemically available in this waste. These include enough Al2O3 to produce 5,000,000 tons of Al, enough Fe2O3 to produce 8,000,000 tons of Fe pellets, enough SiO2 and CaO to produce 24,000,000 tons of building products, and such chemicals as TiO2, K2O, Na2O, and P2O5 in sufficient quantity to make recovery profitable. The technology for recovering these products must be developed in the near future.

07845

Parker, A.

WHAT'S IN THE AIR J. Inst. Fuel, 40(315):173-175, April 1967.

We each breathe about 35 lb of air in a day, consume 3 to 4 lb of drinking water and 1 1/2 lb of dry food. This provides energy by oxidation of carbon and hydrogen of which the thermal value is about 12,000 Btu. equivalent to that provided when 1 lb of coal is burnt. Some of this energy is given out as heat, say about 400 Btu/h. Records of smogs in various countries since 1873 exist, but that in London in 1952 had great effect leading to the b8beaver Report and the b8clean Air b8act, 1956. 2.7 million ton of smoke were discharged into the air during 1938 in Britain, of which 63% was from domestic sources, 10% from railways and 27% from industry. This was reduced to 1.1 million tons in 1965, of which 0.9 million, 80%, was from domestic sources. This reduction was also helped by the rationing of coal during the years of World War II and by the desire for cleaner domestic heating methods. 4.1 million tons of sulphur dioxide were discharged into the atmosphere in Britain in 1938 and 6.4 million tons in 1965, but the concentration of SO2 in the air near the ground has stayed the same. The problem is not yet solved. About 14 million motor vehicles in the U. K. emitted perhaps 5 million tons of carbon monoxide and 1/4 million tons of hydrocarbons in 1965. The interaction of hydrocarbons, oxides of nitrogen and ozone, in sunlight causes the smogs of Los Angeles in which visibility is scarcely reduced and so they are of a different character from London smogs. The International Union of Air Pollution Prevention Associations was recently founded. Its first international clean air congress was held in London in October, 1966. (Author's abstract)

13429

National Coal Assoc., Washington, D. C.

BITUMINOUS COAL FACTS 1968. 107p., 1968.

This biennial report, through text and tables, indicates that known reserves of coal can be recovered to meet present and furture energy needs and that advances in mining and transportation have been matched by technological advances in the handling, burning, and processing of coal. It is estimated that coal now generates 53% of the nations electricity and 65% of the power produced in steam plants. In addition, it is predicted that coal will be converted to pipeline-quality gas to supplement dwindling natural gas supplies. Uranium breeder reactors will not even be competitive with coal by 2000. Bituminous Coal Research, Inc. (BCR) is already at work on a two-stage superpressure gasification process. Its coal-to-gas reactor has a capacity of 100 pounds of coal an hour. The best coals for the process are being revealed by coal petrography, which breaks the coal code and translates coal into coal constituents. BCR is also studying the removal of pyritic sulfur from coal during pulverization and before combustion and is mine-testing the continuous removal of float dust generated by coal-cutting machine. The report contains the following six statistical indexes covering the years 1920-1967: bituminous coal and energy; markets; production; transportation; manpower and safety; and reserves.

13513

Olmsted, Leonard M.

FAST BREEDERS NEEDED SOON TO CONSERVE URANIUM ORE. Elec. World (12th Annual Nuclear Report), 167(24):109-114, June 1967.

The ultimate goal for nuclear power is to achieve complete and perpetual self-sufficiency in fuel supply. The objective is to develop a power reactor which will breed twice as much fuel in ten years as it consumes. In the fast-neutron spectrum, PU239 and Pu-241 both have adequate breeding ratios (1.1) and U233 mixed with thorium offers some hope of success. Most breeder projects today are focused on mixed-uranium-and-plutonium fuel in a liquid- sodium-cooled reactor. Sodium-cooled commercial fast breeders of 1000 to 1200 Mwe are anticipated for service by 1978 if operating and fuel costs can be controlled. Steam-cooled breeders are being investigated by Germany and U. S. Interest in the steam-cooled concept generally reflects the belief that it required less new technology and can be applied several years earlier than the sodium-cooled only at lower capital cost. The possibility of using a gas-cooling system is being investigated by the U. S. It is hoped that a gas-cooled breeder could be completed by 1979 or 1980 at a relatively low capital cost. With fuels estimated as low as 0.5 mill/kwhr, it could achieve a very favorable energy cost.

13587

Chamberlain, C. T. and W. A. Gray

COMBUSTION OF COAL IN OXYGEN. Nature, 216(5121):1245, Dec. 1967. 3 refs.

During an investigation of high-temperature flames, a burner system was developed which can burn up to 6 g/sec of coal in oxygen to form a stable, continuous flame. An integral part of this development has been a study of the mechanism which control the rate of combustion. Coal was ground and graded according to size by sieving and centrifugal classification in air to produce seven fractions ranging from 12 to 70 microns. Flame temperature was measured by the line reversal method which indicated a variation temperature along the length of the flame from 2900 to 3050 K. Each size fraction was burned at two ratios of oxygen to carbon: 2:11 and 1:51. Burning times were compared on the basis of the distances from the burner head necessary for 80% by weight of the coal to be burned. The extent of combustion was determined by a water-cooled sampling probe. It was found that for fractions between 12 and 30 microns there is a linear dependence of burning time on diameter. For fractions between 30 and 70 microns a better correlation was obtained when it was assumed that the burning time was proportional to the square of the diameter. As the particle size is reduced, a critical size will be reached when chemical processes begin to exert an influence on the combustion rate.

13591

Vogely, William A. and Warren E. Morrison

PATTERN OF ENERGY CONSUMPTION IN THE UNITED STATES 1947 TO 1965 AND 1980 PROJECTES. Preprint, World Power Conf., Tokyo (Japan), p. 428-451, 1966. (Presented at the Tokyo Sectional Meeting, Tokyo, Oct. 16-20, 1966, Paper 83.)

The energy needs of the U. S. are met for the most part from domestic sources of petroleum, natural gas, coal, and hydroelectric power. Based on preliminary data for 1965, the total national consumption of energy was equivalent to 13,639 trillion kilogram calories, almost 2/3 greater than consumption in 1947. For the next 15 years it is anticipated that increasing quantities of energy will be needed for the expanded economy. Total consumption of energy in 1980 is expected to be 22,196 trillion kilogram calories, or 63% greater than in 1965. Coal consumption in 1980 is projected at 677 million metric tons, natural gas at 969 billion cubic meters, and petroleum products at 809 million metric tons. Net generation of utility electricity is projected at 2,739 billion kilowatt hours. It is anticipated that 71% of the utility electricity generated in 1980 will come from fuel-burning plants, 12% from hydropower plants, and 17% from nuclear power plants. Petroleum will remain the main energy source for transportation through 1980, with resource inputs exceeding the 1965 level by 69%. In household, commercial, and industrial sectors, combined inputs of direct fuels and utility electricity are projected to exceed 1965 levels by 71% and 50% respectively. Natural gas will remain the ranking energy resource within these sectors throughout the forecast period. (Authors' summary modified)

14816

Edison Electric Inst., New York, Electric Power Survey Committee

43RD SEMI-ANNUAL ELECTRIC POWER SURVEY. 52p., April 1968.

Results are given of a survey covering practically the entire electric utility industry of the country, including investor owned systems, those of governmental agencies, and rural electric cooperatives. The survey also includes those industrial power installations whose operations are coordinated with the utility systems with which they are interconnected, and which thereby contribute to the public supply. It does not include any isolated industrial or institutional power installations. Survey results pertaining to power system capabilities, loads, gross margins, and energy outputs are presented for each of the eight power supply regions of the United States, as defined by the Federal Power Commission. Also presented are figures which represent the Total Electric Utility Industry of the contiguous United States, including those industrial installations contributing to the public supply. These values are based on the survey totals for the eight regions but incorporate upward adjustments to compensate for the minor omissions in survey coverage previously mentioned. No adjustments have been made to the survey totals for the individual regions. Data in this report pertaining to the manufacture, in the United States, of heavy power equipment for all classes of customers represent substantially all such manufacture in this country. December peak capabilities, peak loads, and gross margins as recorded for the years 1966 and 1967, and as now forecast for the years 1968 through 1973 on the basis of median hydro conditions, are given, as well as forecasts based on assumed adverse hydro conditions for December and summer of 1968 through 1973. (Author introduction modified)

17819

Edison Electric Inst., New York

THE YEAR 2000: AN EEI STAFF STUDY. 44p., Aug. 1967.

Based on consultations with scientists, architects, urban planners, demographers, sociologists, and others, a composite picture of life in the United States is projected for the year 2000 All categories of air travel are expected to increase, although the use of private planes will be closely regulated by the government. The demand for jet fuel will nearly double, and new oil refining technologies will be needed to meet the demand. Alternative fuel possibilities, such as hydrogen or nuclear, may be feasible eventually but do not seem possible by 2000. Mass transit systems will link residential and business areas with regional airports, with conventional steel-wheel, steel-rail systems increasingly replaced by vehicles propelled by air cushions. Two major types of electrically-powered vehicles will probably be in use: the small, fleet-operated electric car for use in recreation areas, parks, or downtown shopping areas; and vehicles that will be able to operate on and off a powered roadway. Family-size electric cars will capture an increasing share of the car market. New electric batteries promise to make electric cars and trucks competitive with their gasoline-powered counterparts. There will be increasing associations of compatabile, coexistant land uses. An area which has a wide range of recreational possibilities may also be managed for forestry, wildlife, flood control, power generation and transmission, and even urban settlement. Buildings will alter their use, from residence to office space, with the needs of the community: multiple-use buildings will be common. Temporary structures such as geodesic domes and inflated balloons will add great flexibility to the design of cities. Downtown shopping areas will be enclosed and completely climate controlled. Small domes over patios, golf courses, and swimming pools also seem probable. Increased control of the climate in individual homes will be evident. Units will be available that will cool the air while cleaning and purifying it, temper the humidity, heat it in winter, control odors, and even regulate ion charge.

18206

18TH ANNUAL ELECTRICAL INDUSTRY FORECAST. Elec. World, 168(12): 121-136, Sept. 1967.

A general upward trend in power generation, plant construction, and electric consumption is predicted for the period 1967-71 in a series of seven articles. Economic indicators as of mid-Sept. provide the basis for predicting a kwhr growth for 1967 of 6.2% above the previous year. While residential sales have carried their share of the growth for the year with a projected 7.5% rise, industrial sales have shown an increase of 8.9% over 1966. The electric power industry plans to build 102,400 circuit miles of new overhead transmission lines, 2000 cable miles of underground transmission, to install 21,700 3-phase T&D substation transformer banks aggregating 732,000 Mva, to erect 231,733 miles of overhead distribution, to bury over 77,700 cable miles of underground primary distribution lines, and to install over 195-million kva of new distribution transformers from 1967 to 1973. Significant increases in kwhr sales from 1970 to 1985 are predicted for use in producing aluminum and magnesium, and for use by the AEC. Aluminum and magnesium production should require 76.8 billion kwhr by 1970, 95.5 billion by 1975, 109.3 billion by 1980, and 153.6 billion by 1985. The AEC's usage should grow from an estimated 18.8 billion kwhr in 1970 to 56.4 billion in 1980. Present plans call for about 8000 Mw of nuclear units to be installed in 1971. It is reasonable to expect installations to reach 12,000 Mw in 1975, 22,000 in 1980, and 30,000 in 1985. This would mean investments of about 15 billion dollars during 1985, some of which will be directed to reducing air and water pollution.

21287

MAINTENANCE OF CLEAN AIR. (Reinhaltung der Luft). Text in German. Oel Gasfeuerung, 14(10):1020-1024, 1969.

The major sources of air pollutants are industries, vehicles, and domestic heating. In the industrial sector, power plants, cement kilns, steel plants, and the chemical industry are the primary sources for pollution. Air pollutants may affect humans, animals, and plants. The harmfulness of dusts is determined by their composition, grain size, and shape. Fine dust particles which penetrate into the lungs are particularly dangerous. Soot requires special attention because it may be a carrier of toxic and carcinogenic substances. The most dangerous gaseous pollutants are carbon monoxide, sulfur dioxide, fluorine, chlorine, and unburned hydrocarbons. The federal government is sponsoring a program of air monitoring and research and development; it took legal measures to avoid or reduce air pollution. Large industrial plants must fulfill stringent regulations laid down in the 'Technical Directives for the Maintenance of Clean Air'. The federal law on preventive measures for the maintenance of clean air requires the installation of automatic measuring stations in industrial centers. Automobile exhausts, too, will soon be subject to regulations.

21289

Effenberger, Ernst

AIR POLLUTION, A PROBLEM OF HYGIENE. (Die Verunreinigung der Luft, ein Problem der Hygiene). Text in German. Z. Allgemeinmed., 46(6):283,-293, 1970. 43 refs.

Fuel oil consumption in the Federal Republic of Germany increased from 1.37 million tons in 1954 to 48.16 million tons in 1967; mineral oil consumption rose from less than 5 million tons in 1950 to more than 90 million tons in 1970; and hard coal consumption declined somewhat in the years between 1950 and 1967. The increasing use of natural gas was not high enough to have a profound impact on the air pollution situation. A great deal of sulfur dioxide and fly ash is produced through domestic heating. Otto engines emit carbon monoxide, aldehydes, numerous hydrocarbons, nitrogen gases, and oxidation products of various additives such as lead. Diesel engines emit primarily nitrogen gases. In connection with adverse weather conditions such as inversions, air pollutants may cause such episodes as those in the Meuse Valley in 1930, Monongahela Valley in 1948, and London in 1952. The Technical Directives for Maintenance of Clean Air set the maximum allowable atmospheric concentrations for dust in residential areas at 420 mg/sq m/day (average annual value) and 650 mg/sq m/day (average monthly value), and in industrial areas at 850 and 1300 mg/sq m/day. The maximum allowable atmospheric concentration for SO2 is 0.4 mg/cu m air (long-term value). A short-term concentration of 0.75 mg/cu m is admissible. Sulfur dioxide is known to affect the respiratory tract. It can be removed from flue gases by absorption, adsorption, and by catalytic processes. Average carbon monoxide concentrations of 0.005% by volume were measured in the air above Chicago and Hamburg; 0.007% in Moscow; and 0.008% in Berlin. Benzpyrene measurements in Hamburg in December 1961 revealed a maximum value of 336 micrograms/1000 cu m air (1050 microgram 3,4-benzpyrene per gram dust were measured). In summer, the concentrations were below 20 micrograms/1000 cu m air. A correlation has been found between lung cancer and the benzpyrene concentration of the ambient air.

21360

Northwestern Univ., Evanston, Ill., Committee on
Environmental Policies

ON ACHIEVING CLEAN AIR. 33p., April 21, 1970. 60 refs.

The concern of the ad hoc committee on Environmental Policies has been air pollution in Chicago. Sulfur dioxide and particulate matter are the only pollutants presently monitored in Chicago. Other pollutants include carbon monoxide, sulfuric acid, and nitrogen oxides. It is recommended that H2SO4 levels be monitored in view of the probate connection of this substance with toxic effects of pollution. Commonwealth Edison Co. should be encouraged to continue with reduction in the burning of high sulfur fuels, and should begin to monitor radioactivity in the vicinity of its power plants. Improvements in existing particle removal facilities should be implemented, and the electrostatic precipitators should be upgraded with respect to the weight of particles removed. Commonwealth Edison should contribute financial support to intra-industrial cooperative research leading to improved SO_2 removal systems, nitrogen oxide removal systems, and processes for the removal of particulates less than 1 micron. Abatement policies should not rely on any single method of control. Technologies of fuel substitution, demand reduction, installation of precipitators of high efficiency, and elemental sulfur removal should all be explored. Management should concentrate its attention on both consumers and stockholders, to permit changes in abatement policy. The socio-economic problems of air pollution abatement are also discussed.

22794

Wein, W.

CONSTRUCTION OF POWER PLANT STACKS IN THE LIGHT OF PRACTICAL EXPERIENCE. (Betriebserfahrungen mit Kraftwerkschornsteinen und ihre Konstruktion). Text in German. Mitt. Ver. Grosskesselbesitzer, 48(6):436-444, Dec. 1968.

The three types of power plant stacks which perform satisfactorily are single or collecting stacks with a shaft of brickwork, steel concrete or a combination with an acid resistant lining with or without a space that can be ventilated, single concrete stacks with a suspended insulated steel flue duct, and a frame structure with several suspended insulated steel flue ducts. Stacks can be damaged by excessive thermal stress, by too short a drying time, and by corrosion of and damage to brickwork, mortar or concrete. To prevent excessive thermal stress, heat conduction stacks must be lined to a height of from one third to one half with a thermal protective lining, but a lining of the entire height of the stack is recommended, especially for steel concrete shaped brick stacks. The maximal permissible temperature difference between the outside and the inside surface of brickwork stacks, depending on thickness, is 140 C; for steel concrete and concrete brick stacks, 20 C. These temperatures must be periodically checked. Newly constructed stacks must be brought into operation very slowly so that the humidity in the mortar or concrete are not expelled to quickly. The danger of corrosion caused by the oxidation of sulfur dioxide to sulfur trioxide, the formation of sulfuric acid and its condensation can be minimized by firing with a small surplus of air which reduces the condensation point of H_2SO_4. Measuring instruments recommended for smokestack damage prevention should measure pressure or underpressure in the flue and in the space between the lining and stack, the temperature gradient of the flue gas from foot to top of the stack, carbon dioxide content between stack and lining, and the temperature difference between the inside and outside walls of the stack.

23125

Berry, R. Stephen

PERSPECTIVES ON POLLUTED AIR-1970. Bull. At. Sci., 26(4):2, 34-41, April 1970.

An overview of the air pollution situation considering social, technological, political, and economic aspects is presented. Sources of pollution are categorized as heat and power generation, industrial processes, wasted disposal, and tranportation. All show a great potential for increase in the near future that will probably override the effects of currently proposed control methods. Types of metropolitan air pollution are identified as grey pollution and brown pollution. Newer cities not relying heavily on coal are characterized by the brown smog of automotive pollution. Older cities and cities where coal is important in the economy are characterized by a grey, particulate pollution. There is mounting evidence that the former cannot exist in the presence of the latter because of the inhibiting effect of sulfur dioxide on the formation of photochemical smog. It is emphasized that the direction of effort in pollution control has and will continue to be a direct reflection of the ease of identification of specific pollutants. As technology permits the identification of more pollutants in smaller quantities, evaluation of their effects and instigation for their control will proceed apace. Control strategies are evaluated with respect to type, cost, and time. Easiest and cheapest to control are dramatic 'episodes.' This can be accomplished by reducing peak pollution concentrations for a few critical hours or days during adverse weather conditions. Reducing chronic pollution levels is usually both slow and expensive. Short-term, intermediate, and long-term strategies are all recommended, with careful consideration of the effects of the 'cure' preceding its implementation. Representative is the case of power where the short-term plan would involve conversion to gas or low-sulfur coal and oil. Since all of these are in short supply, an intermediate program of fuel desulfurization and mine-head gasification should be rushed through. Still further in the future would be plant re-siting, power transmission via superconductors, and replacement of existing facilities (40 year life) with non-polluting systems. Opinion is presented on who should bear the costs of these programs. A significant recommendation is for the creation of 'micro-NASAs' to perform crash investigations of the technological problems. The National Laboratories are suggeste as the starting point for this effort. Enough major problems of research, development, and engineering in environmental control exist to justify long-term support for such programs.

AUTHOR INDEX

A

ABE, M *D-05428
ABE, S *N-04212
ABERNETHY R F *F-17592
ABERNETHY, R F *A-06351
ACTON H *B-19480
ADAMS, P J *A-05846
ADAMS, R E *B-04755
AKAZAKI M *F-24272
AKBRUT A I *B-15665
AKULOV K I *G-16192
ALEKSANDROV V P *B-13983
ALPERT, S B *K-00167
AMBROSE, M J B-10770
AMBROSIA D A C-23121
ANDERSON J B L-12461
ANDERSON W C *B-19670
ANDERSON, D M *D-03432
ANDERSON, E W *L-01399
ANDERSON, J D-11525
ANDRITZKY, M *A-11411, *A-11637
ANGELOVA G *A-13978
ANON *F-11135
ANTHROP D F *A-23619
ANTIPIN V G A-13261
ARAI K *C-16149
ARAI Y *F-16376
ARAKAWA Y *A-13293
ARAKI Y B-15693
ARIN M L *E-21099
ARITA S B-15692
ASANO T *B-24673
ASCULAI E *E-24391
ASHLEY, R W *C-11755
ATHANASSIADIS Y C *A-21999
ATSUKAWA M B-12442, *B-15841,
*B-15844, B-16346, *B-16548, B-24589
ATSUKAWA, M *B-04655, B-11252
ATTIG R C *B-12797
AURIELLE R *B-22560
AUSTIN H C *B-13394, *B-19034
AUTHIER R B-15358
AYNARD A A-13855
AYRES S M *G-21276

B

BABCAN J *B-11985
BABCOCK L R JR *A-25418
BACHL H *A-11968
BACHL, H *A-10678, *A-11640
BACHOFER J L JR B-14730, B-16862
BACHOFER, J LC JR B-11233
BACON R F *B-19560, *B-22001
BADZIOCH S *A-25108
BAHNO G *B-24707
BAIER, E J *F-07059
BAILEY A L A-17418
BAKER, A F *B-00276
BALAZS Z *A-15146
BALDWIN C J *A-18176
BARANOV, A P *A-04287
BARBER J C *B-25038
BARBER, F R A-01510, D-02046,
*D-08858
BARBER, J C B-02192
BARNHART D H *B-17782
BARNHART, D H *B-05857
BARRETT A A *B-25164
BARRETT R E *B-20539
BARTMAN J S B-14730, B-16862
BARTMAN, J S B-11233
BARTOK W *A-12619, *B-22861, *B-24678
BARUT R F B-19480
BARWASSER J B-24270, B-24554
BASAK G C *B-22981
BASHIROVA F N *H-19620
BATHKE W L A-26085
BAUM, M M *F-09064
BAXTER, W A *B-12574
BAYLISS, R J *A-02860
BEAN E H *B-18111, *B-22127
BEARD, C G II A-02765
BEECHING W E J *B-25663
BEINE H *A-23884
BELL G B *D-22812
BELL G G *E-23723
BELLE P *B-15616
BELLER M A-12266, A-23954
BELOT, J R JR *B-08926
BELYEA, A R *B-07962
BELYEA, H A *C-03460, L-01399
BENARNDT W *B-20243
BENCOWITZ I *B-19560
BENDER R J *B-24190, F-13400
BENDER, R J *B-09699
BENLINE, A J *L-01265
BENNER R C *B-19378, *B-19672,
*B-22012, *B-24516
BENNETT R R *A-20736
BENSON C S *E-24109
BENSON H E B-20663
BENSON, H E *A-08390, B-03337, B-06278
BERGE, H *M-01567
BERGEMANN, G O *B-08940
BERGER, A W *E-11624
BERGMANN G *F-22319, *F-22587
BERLYAND M Y *E-17612, *E-20042
BERLYAND, M E *E-10368
BERLYAND, M Y *D-10723
BERMAN P A *B-20779
BERMAN, P A *A-04652
BERNHART, A P L-01399
BERNHOFF R *B-24613
BERRY R S *N-23125
BERRY, A E L-01399
BESPALOV A I *G-12289
BETTELHEIM J B-17004, *B-25494
BEVANS R S *B-23027
BEVERIDGE G S G *A-14400
BIEBER K H *B-21313
BIEDERMAN N P *A-19511
BIENSTOCK D *A-22387, *A-23359,
*B-14566, *B-20663, B-21005
BIENSTOCK, D B-02407, *B-02908,
*B-03337, *B-03581, *B-06278,
*B-06543, B-11191, *J-01707
BILLINGE B H M *B-23315
BILLINGE, B H M *B-02778
BILLINGS C E *E-21099
BILLINGS, C E E-11624
BINS, R V *B-02909
BISHOP, J W *B-11178
BLADE, O C *A-12576
BLECHER, K J *B-02206
BOCKRIS J O M *F-14686
BODURTHA F T JR *E-24486
BOGATENKOV V F A-13261
BOKOV, A N A-02549
BOLL, R H *I-04622
BOORAS S G *L-17321
BORGWARDT R H *B-12308
BORGWARDT, R H *B-04842, *B-05310
BORIO R W B-13639, *B-14838
BOROZDINA L A *B-15244
BOTTERILL, J S M *L-12031
BOUILLIOT R *B-20073
BOUX J F *B-22175
BOVIER R F *B-15031
BOVIER, R F *B-02727, *L-03277
BOVING J O *B-13569
BOWEN H J M *A-21383
BOWIE W S *B-15532, *B-20485
BOWNE N E A-14997
BOYER A E *C-20224
BRACKETT, C E *J-06845
BRANDON J H *C-16860
BRANTNER, H *L-11383
BRENNAN P J *B-13856
BRENNAN, E H-05420
BRENNAN, N E *B-05198
BRESSER, H *C-02668
BRETSCHNEIDER B *A-14701, *J-11995
BRIER G W *B-25164
BRIGGS, G A *E-10608
BRIVIO L *B-19724
BROCK J R *A-25213
BROCKE W *B-21886
BROGAN, T R *A-03072
BROHULT, S *E-10153
BROWN R F *B-25047
BROWN, G A *F-00105
BROWNE, W R *B-11929
BRUN, M *E-06775
BRUNN, L W *B-03337
BUCKLEN, O B I-11286, *N-04432
BUEHLER M E *G-21276
BULL, W C B-01187
BURCHSTED C A *B-20437
BURDOCK, J L *B-09191
BURGART, H F *F-01380
BURNS L S *L-26157
BUSBY H G T *B-25127, *B-25786
BUSH, R I *L-13049
BUZUNOVA, L V *A-02549

C

CADWALLADER L W *B-23220
CAHILL, W J JR *B-08348
CALHOUN, F P *A-10740
CAMBEL A B *B-25529
CANTER L W *C-24412
CANTRELL R R *B-25560
CAPP, J P *B-08938
CAPPONI P *K-22248
CARLS E L *B-20425
CARLTON H E J-15510

CARPENTER S B •C-15479, •E-17580
CARPENTER, S B A-00691, C-02921, E-00023, E-04033, E-04034, E-04035, •E-06373, E-06823, •E-10421
CARPENTIER, J •G-01340
CARSON J E •L-12461
CARSON, J E •D-09984, •D-11525, •E-11065
CARTER C •A-13102
CARTER, R P D-09984
CASSELL E J •G-18109
CASTLEMAN A W JR •A-23170
CATCHPOLE S •B-19029
CATCHPOLE, S L-02052
CAVE G A •A-24005
CEMBER H •A-21916
CHADWICK W L •B-13394
CHAMBERLAIN C T •N-13587
CHARMBURY H B •B-19602
CHASS R L •B-21594
CHASS, R L •B-04516
CHATTERJEE, A K •F-10422
CHEDD G •B-22103
CHEKANOV G S •B-22661
CHEN, P M B-11178
CHEN, Y F-11782
CHERTKOV B A •B-19629
CHIRONIS N P •A-18052
CHOVIN P •A-17357
CHOW T J •A-23239
CHRISTIE, J •A-10743
CISLER W L •A-25256
CITARELLA J F •J-12418
CLARK, F L D-09984, E-11065
CLARKE A J •B-23237, •D-16237
CLARKE H •B-16250
CLARKE, A J B-02311, •L-02052
CLEARY, G J •A-10424
CLENDENIN, J D •A-08392
CLIFTON, M •D-02057
CMARKO V •A-11988
COCHRAN N P •B-13813
COCHRAN, N P •B-05529
COCKRELL, C F •B-08936, •B-09904, •N-04432
COHEN P •A-13401
COLBAUGH W C E-17580
COLLINS A C •B-23315
COLLINS R L B-21241
COLLINS, A C •B-02778
COMMINS B T •A-16877
CONKLIN E R •A-13892, •F-13191
CONNER, W D •C-03546
CONRAD G •B-22500
CONTROL METHODS •B-24073
CONVENEOVOLE, M •G-01340
COOPER D R •B-16502
COPELAND A E •B-14001
COPELAND, J O •B-10493
COPIAN, L P A-05169
CORBETT P F •B-13767
COREY, R C •B-09996
CORTELYOU C G •B-16418, •B-16851
COUTALLER J •B-17672
COUTANT R W •B-20539
CRAIG T L •B-20552
CRANE, W M •B-12672
CRAVITT, S C-01354
CRAWFORD A R •A-12619, •B-22861, •B-24678
CRAWFORD H L •A-21221
CRAWFORD, W D •B-10655
CRAXFORD, S R •A-01350, •D-02057
CREAGAN, R J •A-05530
CRENTZ W L •A-17418, •B-13835
CROKE E J •E-19737, E-25229, •L-12461, •L-17321
CROKE K G L-12461
CROKE, E J •D-09984, •D-11525, •E-11065
CROKE, K D-11525
CSABA, J •F-09064
CSANADY, G T •E-05357, •E-07801
CUFFE, S T A-03113, •A-05067, •C-03592
CULKOWSKI W M •E-24509
CUMMINGHAM, A T A-10444
CUMMINGS W G •C-22885
CUMMINGS, W G •E-01259, •E-01260, •E-01261
CUNNINGHAM A R B-22861
CURRAN G P •B-16279

D

DAILY, W B •B-09546
DAINES, R H •H-05420
DAMON W A •L-24033
DAMS R •C-25231
DARBY K B-25127, •B-25786, •B-25833
DAVIDOVSKIY G A B-15665
DAVIDSON W C •B-22051
DAVIES D T •F-18170
DAVIS, F F JR •B-10770
DAVIS, K •G-11300
DAY A G III •F-14851
DAY C E JR •A-16888
DE TURVILLE C M •E-21736
DEALY J O •C-12510
DEAN R S •B-24048
DEBERRY D W B-25416
DEBRUN G •C-25147
DEBRUN, G •B-07359, •B-13057
DECARLO J A •A-16212
DECARLO, J A •A-03340, •B-05454
DECORSO, S M B-10770
DEGNER B •B-22501
DEGTEV O N •C-22982
DELANGE, J E •C-07787, •C-09107
DELYAGIN G N •F-14390
DEMARRAIS, G A •E-02410
DEMETER J J •A-22387
DEMPSEY, J F •B-09971
DEMSKI R J •A-23359
DENES S •B-16496
DENISOV, A M •B-04634
DENNIS C •B-18143
DENNIS C S •B-24985
DENNIS R E-21099
DENNIS, R E-11624
DENOVAN, A S •C-11755
DETURVILLE C M •E-16803
DEURBROUCK, A W •B-00276
DEVOTO, G D-08298
DIAKONOFF S •B-25320
DIAKUN, R F-07059
DICKINSON R •L-20698
DICKS J B •A-23379
DICKS J B JR •A-19024
DIEHL E K •B-17782, •B-18154, •B-21234, •L-14535
DIEHL, E K •B-01362, •B-05857, •C-00945
DIGIOVANNI, H J •C-01354
DILLARD J K •A-18176, F-16589
DINNEEN, G U A-08391
DOMAHIDY G •B-19845
DONAHUE, B A N-04432
DOTTREPPE GRISARD N •D-23326
DOUGLAS J •B-22071
DOUMANI T F •B-15962
DOUSA K •A-11982
DOWD J T •B-16815
DRAGOUMIS, P A-03072
DRATWA H •A-14574
DRATWA, H •B-08371
DRINKER P •A-24039
DRISCOLL J E-21099
DRUCKER, E E •N-05194
DRYDEN I G C •A-13494
DU BREUIL, F •C-00945
DUBROVSKAYA, F I •D-07141
DUEMMLER F •L-17472
DUEWEL L •C-19519
DUFFEE R A •C-26139
DUFFEE, R A •C-04040
DUKES, R R •B-11238
DUMARCHEY G A-13855
DUMONT A H •A-17910
DUNCAN, D C A-08388
DUPREY, R L •A-09686
DURIE R A •B-24630
DUUREN H V •C-14733
DUZY A F •A-12120
DUZY, A F •A-02630
DYMSHITS S A •A-17017

E

EARL J L •A-23239
EARLEY W T B-19642
EBERT K •A-21318
EDDINGER R T A-13410, F-11782
EDOUARD L •B-22401
EFFENBERGER E •N-21289
EFFENBERGER, E •D-06755
EGGER A •B-23773
EHRLICH S •B-20063
EHRLICH, S B-11178
EINBRODT, H J •G-06806
EISENBUD M •A-21351
EISNER J H •B-25139
ELDER, J L A-02631
ELDIB, I A •B-04506
ELLIS R B •F-14512
ELLIS W T •B-25184
ELLISON, J M •C-00886
ELSHOUT A J •B-16224, •C-14733
ELSHOUT, A J •D-02979
EMICKE K •B-24441
ENGDAHL R B B-15516
ENGELBRECHT, H L •B-01485
ENGELMANN H D F-22319
ENGELMANN, R J E-10608
ENGELS, L H •B-01712
ENGLE, C F •B-08938
ERDMANN R C •A-25975
ERGUN S A-18114, •B-18111, •B-22127, F-14814
ERNST AND ERNST •J-11111, •J-11114
ERTL D •B-14294, •B-14473
ERTL, D W •B-07931
ESSENHIGH R H F-14851
ETTINGER, H J •C-01363
EVANS R K •A-18276, •F-13400
EVANSON, A E •J-00978
EXLEY L M •B-20082
EXLEY, L M •B-03974

F

FALKENBERRY, H L •B-11240
FAORO, R B D-05551
FARKAS L •B-16496
FARKAS, M D B-11238
FARMER, J R L-01890
FARR J W •B-22552
FARRIOR, W L JR •F-08941
FASCHING G E B-15543, •C-25260
FASCHING, G E F-09769
FEILER W •B-25186, •B-25269
FELDMAN H F •B-21005
FELDMANN, H F •B-11191
FELIX R •A-19165
FELIX, F •J-02918

FELS M *A-21221
FENSTERSTOCK, J C *D-05551
FERGUSSON G J F-14851
FERNANDES, J H *B-00140, *B-09546
FERRAND E F *B-25187
FIELD E L *A-16722, *B-24922
FIELD J H *B-12253, *B-14566, *B-19471, *B-20663
FIELD, J H B-01245, *B-02407, *B-02908, B-06278, *B-06345, *B-06543, *B-07417, *B-09666, *J-01707
FINFER, E Z *J-00166
FINK C E *B-16279
FINK K *J-20054
FISCHER, G *L-11383
FISH B R *A-16855
FLETCHER B L *J-15510
FLODIN, C R *B-05853
FOGEL M E *J-21241
FORD E *B-18161
FORNEY A J B-25503
FORREST J S *B-26143
FORTAK H *A-15701, *E-22313
FOSTER P M *A-16788
FOSTER, M D *E-08400
FRANCIS W *B-19394, *B-23879, *B-24697
FRANKEL, R J *B-12040
FRANKENBERG T T *J-25961
FRANKENBERG, T T *A-10284, *B-00135, *B-01796, *L-06615
FRANTZ, R L *A-13053
FRASER T *A-17418, *B-13835
FRAZIER J H *B-13857
FREDRIKSEN H *B-25584
FREY D J *F-13411
FREY, D J *I-11286
FRIEDLANDER G D *A-25867, *M-25193
FRIELING G B-14137
FRIELING, G *B-03879
FRIELING, G G B-07430
FRITZE E *G-14530
FRIZZOLA J A *E-15511
FRIZZOLA, J A *E-06373, E-10421
FRYSINGER, G R *B-02442
FUDURICH, A P C-06095
FUJII T *E-17734
FUJISAWA, K D-07951
FUKUI S *B-16346, *B-20392, B-24589
FUKUI, S *B-11252
FUKUMA S *B-20526, *F-13487
FULLER A B *B-20437
FULWEILER W H F-18185
FUQUAY J J *E-24407
FURUTO K *B-24643

G

GALLAGHER J J B-21005
GAMBS G C *A-20863, *A-25689
GANCHEV, B G *A-09103
GARDNER, J W *L-00206
GARTRELL F E *B-25038, *C-15479
GARTRELL, F E B-02192, *B-04200, *C-01856, *C-02921, *E-00023, *E-04033, *E-04034, *E-04035, *E-06823, *N-03344
GARVEY, J R *A-02501, *L-06735, *M-08072
GATZ D F L-12461
GATZ, D F D-09984, D-11525
GEER, M R *B-09523
GENIKHOVICH Y G *E-20042
GEORGE R E *B-21594
GEORGE, R E *B-04516
GERBER A *A-18177
GERBER, A *A-07642
GERMERDONK R *B-23504
GERMERDONK, R *B-04791
GERSTLE R W J-21241
GERSTLE, R W *A-03113, A-05067, *A-11502
GIBSON F H F-17592
GIBSON, F H A-06351
GIFFORD F A JR *E-24569, *E-25935
GIFFORD, F A JR *E-05702
GIL DENSKIOL D R S E-16687
GIL DENSKIOLD, R S *E-10219
GILL, J S *B-04755
GILLHAM, E W *D-02046
GIRSEWALD C B V *B-24554
GIRSEWALD C F V *B-24270
GITSAREV A I B-15665
GLASER P E *A-18056
GLEASON, T G B-07752
GLENN R A *B-13171, *B-14891
GLENN, R A *B-01866, C-00945
GLENSY, N *B-00272
GLUSKOTER H J *A-12202
GLUSKOTER, H J *F-04827
GOADBY, S C *C-07941
GOFF G B A-19038
GOFMAN M S A-13330
GOLDBERGER, W M *B-08870
GOLDSCHMIDT K *B-11854, *B-19339, *B-21028
GOLLMAR H A *B-26211
GONSCHOREK D *L-21431
GORIN E B-16279, B-17338
GORMAN P G A-25196
GOROSHKO, B A *E-10219, *E-10220
GOSSELIN, A E JR *B-07075
GOURDINE, M C *A-09194
GRABOWSKI H A B-14838
GRAFF R A B-15284
GRAHAM J B-23315
GRAHAM J I *F-13766
GRALA M *B-25744
GRAY W A *N-13587
GRAY, C A F-11782, *L-11283
GRECO J B-13674
GRECO, J *B-08863
GREGORY, A R *H-00316
GREGORY, J A D-09984, D-11525
GRIFFITH R H *B-19876
GRIGORYAN, G O *B-10591
GRINDELL, D H *C-01857
GRISWOLD, S S *B-00107
GRONHOVD, G H *A-09161
GROUT J M *A-11790
GRUBER, C W *A-00532, *C-11193
GUIETTE J L *A-17910
GUNDEL E *G-14530
GUREVICH, A M A-02549
GUSEV M I *G-16192
GUTHRIE, C E B-04755

H

HAAGEN SMIT A J *B-14632
HAALAND, H H *B-05853
HAENISCH E *B-19380
HALEY, H E *B-06136
HALITSKY, J E-10608
HALL H J A-12619, B-22861
HALS F A *A-21204
HALSTEAD W D *F-16883
HALZEL G C *B-16746
HAMM, J R *B-02424, *B-09905
HANBY V I *B-21136
HANGEBRAUCK R P A-15391, *A-24732, *B-15544, *B-19340, *B-21268
HANGEBRAUCK, R P *B-08429
HANIG G *B-21893
HANKS, J J *J-01546
HANSBROUGH, J R *B-07786
HANSCH, W C-02668
HARA M *F-24272
HARADA Y B-14394
HARPPORTE D R D *A-22159
HARRINGTON, R E *B-04842, B-05310, *B-07466
HARRIS R D *B-14891
HARRIS, D N *L-05666
HARRIS, R D *B-01866, *B-04[illegible]07, *F-02743
HARRISON D *B-25165
HART S J *B-14270
HARTNER F E *A-16256
HARTNER, F E *C-07516
HARTWIG J *B-19692
HASEBE S *B-15692
HASEK M *E-11980, *E-26267
HASHIMOTO K *B-17343, *B-20097
HASZ I *A-22418
HATTORI H *B-13721
HAUSBERG G *B-19803
HAWKSIEY P G W *A-25108
HAYASHI T B-23447
HAYASHI Y C-22391
HAYNES G N *B-14001
HAYNES, W P *B-08347
HEARN, B B-02778
HEIN L B *B-14322, *B-23221
HEITMANN H G *B-25637
HELLER, A N *D-01790
HELLWIG, K C *B-09195
HENKE W C *B-24675
HENRICH, G *B-02971
HENSEL R P B-13639, B-14838
HEPTING, G H *H-01014, *H-01398
HEREDY L A *B-25913
HERTEL, W *B-07229
HERTVIK, Z *B-04179
HERZOG G *B-14660
HESTER, J A *B-08925
HEWSON G W *B-19395
HIDY G M *A-25213
HIGASHI M B-16346, *B-20392, B-24589
HIGASHI, M B-11252
HIGGINSON K *M-25143
HIGH M D *L-18121
HILEMAN A R *F-16589
HILL E L J-21241
HILST G R *A-14997
HINDS W T E-24407
HINO M *E-26141
HINO Y *A-13644
HINO, M *E-10010
HIRAI H B-14394
HIROSE R *A-25690
HODKINSON, J R *C-03546, *C-04759
HOEGSTROEM, U *E-10751
HOEHLE R *A-21286
HOFFMANN K *B-26155
HOLBROOK E A *B-13663
HOLDEN J H B-15532, B-20485
HOLDEN, J H F-09769
HOLL, R E *A-02014
HOLLAND, C T A-06978, *B-07425, L-13049
HOLZWORTH, G C *E-02410
HOMMA M *E-19503, *E-26141
HONMA T *E-17725
HORIUCHI K *E-17734
HORLACHER W R JR B-14730, *B-16862
HORLACHER, W R JR B-11233
HORN K *A-15246
HORVATH T *B-15976
HOSHIZAWA K *A-24817
HOSLER, C R E-02410
HOULT D P *B-24001
HOVEY M W *B-19733, *B-22809

HOY, L W *B-08937
HRADECKY F *A-11981
HSUEH L *A-26226, *A-26233, *B-26230
HUGHES D F *B-22806
HULL A P *A-23652
HULTZ J A *C-17419
HUMBERT C O *B-25079
HUMPHREYS, K K B-08936, L-13049
HUNTER J B *B-21232
HUSMANN K B-21893
HUSSEY, C E B-10770

I

IDE Y *E-17595
IDELCHIK I Y *B-13983
IL INSKAYA I N B-22661
IMATAKE T B-14394
INARD A B-15616
INOUE A B-19581
IRELAND F E *A-23044
IRELAND, F E *A-12633
ISHIHARA Y *B-21275
ITO A *B-23262
ITO F *B-14194
IWASHIMA, K D-07951

J

JACKSON, W D *F-00105
JACOBS, M B *D-06824
JACOBSON L D A-26085
JACOBSON M *C-23121
JAEGER W *B-15902
JAFFE, L S *A-10754
JAIN, A K B-11178
JANDER K C-22342
JARA V *B-25494
JARMAN R T *B-25170, *E-16803, *E-21736
JELEN B *B-14707
JELGERSMA, J H *B-10399
JIMESON R M *A-11790, *B-23176
JIMESON, R M *B-00568, *J-02413
JIRASEK, V *C-00403
JIRELE, V *B-08492
JOHNS, R W *C-03460
JOHNSON L W *C-16875, *C-18012
JOHNSON V G A-16887
JOHNSON W B JR *E-15483
JOHNSON, A R K-00167
JOHNSON, C A *K-00167
JOHNSON, G E *B-01245
JOHNSON, W B JR *C-09624
JOHNSTON D R *J-21241
JOHNSTON W H F-14851
JOHNSTONE H F *A-19017, *B-16968, *B-20035, *B-21506
JOHSWICH F *B-13829
JOHSWICH, F *B-01726
JOLLY A A-13102
JONAKIN J *B-16248, *B-17905, *I-13086
JONAKIN, J *L-06737
JONES J F *A-13410
JONES, J F *F-11782
JONES, J R *A-04333, *L-07794
JONES, W R E-01259, E-01260, E-01261
JORDAN C W *F-18185
JORDAN, H V *H-02293
JOYCE, C P *F-01379
JUENTGEN H *B-22905
JUENTGET H *A-19444
JUHASZ A A-15146
JUNTGEN H *B-26084
JUNTGEN, H *B-02970, *B-08371, *B-11055, *F-10429

K

KACHULLE, C *A-11655
KALISHEVSKII, L L *A-09103
KAMEI K B-11252, B-16346, *B-20262, B-20392, *B-20526, F-13487
KAMINO Y *B-19581
KAMMERER, H F *A-11413
KANEKO K B-24269
KANNO S C-12126
KANNO, S *C-07482
KANTER, C V *C-06095
KAPALIN V *A-11988
KAPOOR R K *E-14271
KARAGODIN G M *C-22982
KARZARINOFF A *B-24881
KASAHARA K *B-12417
KATELL, S A-08391, *B-01727, *B-02195, J-01707, *J-08867
KATIN A *L-17473
KATO K *B-17250
KATO Y *B-21324
KATZ B *B-20914
KATZ, J *B-00653
KATZ, M *D-00657, *L-05499
KAWAHATA, M *B-11929
KAWAMURA Y B-19581
KAWASUMI M B-12417
KAYLOR F B *C-20224
KEATING, S J JR *A-02290
KEDRON B B-17318
KENKYUSHO K K *B-13578
KENLINE, P A *D-04116
KENNEDY A S E-19737, E-25229, L-12461
KENNEDY, A S D-11525, E-11065
KENNEDY, AS D-09984
KENNEDY, G F *A-04778
KENWORTHY, H *B-06490
KERCHER H *B-15155
KERREBROCK, J L F-00105
KESTER, W M *B-08898
KETOV A N *B-13817, *B-14057, *B-15946, *B-19619
KETTNER H *A-25549
KHUKHRINA, Y V C-08123
KING, D T *B-07385
KIRAKOSYAN, R M *B-10591
KIREEVA, I S *A-07570
KIRENBIN O I E-20042
KIRKWOOD, J B *A-05506, *B-05508
KIROV, N Y *B-05516
KITAGAWA T *B-12442, *C-12126
KITANI T *B-22160
KITTLEMAN T A *B-12308
KITTREDGE G D B-15544
KIYOURA R *B-23447, *B-25284
KIYOURA, R *B-10692
KIZIM I A *B-22661
KLEIN H *B-21117
KLEINSCHMIDT R V *B-23231
KLIMECEK R *B-17004, *B-19482
KLOEPPER, D L *B-01187
KLUGE W *B-23674
KNAPP E M *B-25184
KNAPP O *B-24642
KNAUER A *A-15246
KNECHT, H *B-09163
KOBAYASHI O *A-25062
KOBAYASHI Y *C-12126
KOCZKUR, E *E-10053
KOEPPE B *B-23674
KOERNER H J *D-23356
KOGAN E I B-13983
KOHN R E *J-15889
KOLAR J *C-15348, *C-17474
KOLBIG J *B-23974
KONISHI M B-15693
KOPITA, R *B-07752
KOROL, D *B-02931
KOSCHANY, E M *B-06062
KOTB A K *B-19189
KOUTNIK J *A-17280
KOVACEVA V A-13978
KOVACH J L *B-26220
KOYATA K *A-24817
KRALIK, O *B-04179
KRANZ M *B-25744
KREIMANN H H *A-13141
KREJCIRIK L *B-11985
KRIZ M *B-13243, *B-17318
KRUG H *B-25186, *B-25269
KRUMIN P O *A-13848
KRUSHINSKAYA G K *B-15913
KRZYMIEN M B-25744
KUBE, H D J-01546
KUBE, W R A-02631
KUKIN, I *B-08080
KUNKA, L M *B-01245
KURIYAMA T B-12417
KURONUMA H *B-23447
KURTZROCK R C A-23359
KURTZROCK, R C *B-07417

L

LAAMANEN, A *L-02011
LAMANTIA C R *A-16722, *B-24922
LAMB, D R *G-11828
LAMBERT, W H L-03277
LAMPE F W F-14851
LANCASTER, B W *B-10003
LAND G W *A-23726, *B-19642, *M-25188
LANDERS, W S *B-11229
LANGMANN R *A-25549
LARIKOV V V *B-14057, B-15946, *B-19619
LARSEN, R I *L-06188
LARSSON O *B-18296
LAUFHUETTE D W *A-19084
LAWTHER, P J *G-06826
LAZAROV L *A-13978
LEASON, D B *B-09469
LEAVITT J M E-04034, E-04035
LEAVITT, J M A-00691, E-00023, E-04033, E-06373, *E-10421, *L-02960
LEBOWITZ H E *B-17338
LEE, P R *L-11319
LEITHE W *B-23373
LEMKE K *B-19804, *B-20223
LEMMON A W JR *J-15510
LEMON, L W *B-04508, *B-07075
LEONARD J W *B-13639, B-14838
LEONARD, J W B-07425, *B-08898, B-08936, B-09904, *B-13051, L-13049, N-04432
LEONE, I A *H-05420
LEPPER G H *B-19394
LEPPER, J M *C-04889
LESOURD D A J-21241
LEVY S I *B-22279
LIBERATORE A J *A-19038
LIEBEN, J *D-03432
LIEBSCHER P A-15246
LILIENFELD, P C-01354
LINDALL A W *G-20700
LINDBLAD A R *B-19541, *B-24565, *B-25787, *B-25795
LINNA E W *B-19642
LIPPMANN, M *C-01354
LITTLEJOHN R F *B-13767
LOONKAR Y R B-23027
LOUGHER E H B-20539
LOVE L R *B-18063
LOWE H J *B-23305, *B-26143

LOWELL P S *B-25416
LOWICKI N *B-21893
LUCAS, D H *E-03557
LUCE C F *A-24951
LUDWIG E G-14530
LUDWIG J H *B-18110, *B-21819
LUDWIG, J H A-00943, A-01480, A-01489, A-01816, A-07759, A-07963, *G-01865, *L-06730
LUETTGER H *B-24642
LULL D E-21099
LULL, D E-11624
LUNCHE, R G *C-06095
LUNDQUIST, N H *A-07793
LUTHER H *F-22319, *F-22587
LYONS D E *A-24978

M

MACARTHUR C A A-14400
MACDOWALL J *E-16285
MACEY H H *E-24243
MACHE A *B-15358
MACTAGGART E F *B-16500
MAGNUS, M N *J-01308
MAHLER, E A J *K-02010
MAIER O *C-22342
MAIKRANZ F *A-11968
MAIKRANZ, F *A-11640
MAJUMDAR A R B-15902
MAL TSEVA T G B-13817
MALACHOWSKI J *B-25743
MANDERSON, M *L-10998
MANDERSON, M C *L-11242
MANNY E H A-12619, B-15148, B-22861
MANOWITZ B A-12266, A-23954, A-24955
MANZ, O E *N-02632
MARKOV B L A-13261
MARQUARDT W *A-21286, *B-19346
MARRACCINI, L *D-08298
MARSH, K J *E-08400
MARTIN J R *B-23140, *B-24168
MARTIN, A *A-01510, *D-02046, *D-08858
MARTIN, A E *G-00981, *G-02417
MARTIN, D O A-01842
MARTIN, G B *B-10680
MASEK V *A-13219
MASHEK V *A-25545
MASTERSON H G B-23315
MASTERSON, H G B-02778
MASUDA T *E-20068
MATSAK, V G *B-08155
MATSUMOTO, K B-04655
MATTHEWS K J *A-14794
MAXWELL C T *A-23753
MAYER, M *A-00972
MAYORS TASK FORCE ON AIR *L-09073
MAZACEK J *B-11996
MAZUNDAR, B K *F-10422
MCCALDIN R O *C-16875, *C-18012
MCCANN, C R *F-01852
MCCARTNEY J T *A-18114, *F-14814
MCCLELLAND, E H *L-00162
MCCREA D H *B-25503
MCCREA, D H B-07417
MCFADDEN, C R N-04432
MCGEE J P A-19038
MCGEE, J A-12541
MCKAY, R D D-00657
MCKELVEY, V E *A-08388
MCKINNON J P *F-16589
MCLAREN J *B-20995
MCLAUGHLIN J F *B-17905
MCLAUGHLIN, J F B-11262
MCLAUGHLIN, J F JR *B-11159, *E-07843
MCMULLEN, T B *D-05551
MEETHAM A R *E-21986
MEETHAM, A R *E-06827
MEGONNELL W H *L-18121
MEGONNELL, W H *J-08059, *L-01585
MEIKLE, P I-11286
MERIK J *D-13176
MERRILL J A *A-26085
MEYER E *E-15347
MICHALCZYK G *B-22740
MICHALCZYK, G *B-06999
MIDDLETON, J T *H-02299
MIELENZ, R C *B-08942
MILLER D M *B-16248
MILLER F G *B-13584
MILLER L A *B-20696
MILLER, L A *F-01379
MILLS C A *G-23670
MINER S *A-19994
MINNICK, L J *F-08943
MITCHELL D R *B-13592
MITCHELL R I C-26139
MITCHELL, R I C-04040
MIURA M *B-25019
MIYAJI M B-19581
MIYAJIMA, M *B-10563
MIZUMOTO Y *B-15841, B-15844
MIZUNIWA F *C-22391
MOFFAT A J *E-16285
MOLISKEY A *B-19261
MONMA, T D-07951
MONROE G R *B-22552
MOODY, J E *J-00253
MOORE A S *C-22882
MOORE, D J *E-03557
MOORE, W W B-09163
MORGAN G B *C-24245
MORI, H *B-03045
MOROZ, W J *E-10053
MORRISON W E *A-13954, *A-13963, *J-13613, *N-13591
MORRISON, R E *B-08921
MOSES H L-12461
MOSES, H D-09984, D-11525
MOSES, R G *B-04507
MUELLER G G-14530
MUELLER G F *L-21431
MUELLER H O G-14530
MUELLER WARTENBERG H *B-21200
MUKAI S *B-15693
MULHERN, J J B-02772
MULLEN, J F *B-08085
MUNIDASA M *B-25284
MURPHY Z E A-16212
MURPHY, E M B-03337, *B-03581
MURPHY, Z E A-03340
MYERS J G B-14566, *B-25503
MYERS, J G B-02407, B-02908, B-06543

N

NAGAI H *B-15092, *B-25088
NAGAI S F-16376
NAGAI, N *I-03222
NAGY K *B-15976
NAKAMURA A *E-20068
NAKAYAMA, K *D-07393
NARJES L *C-16512
NARJES, L *C-02655
NARUO, Y *G-04136
NEEDHAM, W J *B-07673
NEGHERBON, W O *F-00530
NELSON H W *B-15516
NELSON, F *B-00687
NETSCHERT B C *A-18177
NETSCHERT, B G *L-13055
NEULANDER C K *B-22615
NEWELL J E *B-17685
NEWELL, J E *B-11247
NICHOLLS P *F-13572
NIEMEYER L E *A-12335, *D-23957
NIFONG G D C-25231
NIKITINSKAYA, Z P A-02549
NIKOLAEV S P *A-17017
NISHIMOTO K *B-15844
NISHIMOTO, Y *B-04655
NISHIMURA H *B-15251
NIWA T *B-14394
NOBLE R W *A-11860
NOEL R *D-23326
NOEST, J G *A-09075
NONHEBEL G *B-21238
NORCO J E *E-25229, L-12461
NORO, L *L-02011
NORTHCOTT, E *B-08378
NOSE Y *G-23151
NOVOTNY P *B-22961
NOWLAN J P *M-22636
NURULLAYEV, D K *D-05260

O

O CONNOR J R *J-12418
O DONNELL H J *A-18114, *F-13834, *F-14814
OBERHAEUSER A *B-20243
OCHS H J *A-16410
ODA K *B-21275
OEHRLICH, K H *B-10933
OELS H J-17203
OELS, F *B-02053
OESTMANN M J A-21916
OGINO, K I-03222
OHTAKE T *E-24439
OHTSUKA T *B-21643
OHYA M *A-15620
OHYANAGI T B-23262
OKADA, M *I-03222
OKANIWA K *F-17594
OKITA, T *D-07951
OLDENKAMP R D *B-20914
OLMSTED L M *N-13513
ONEAL, A J JR B-03974
ONIKUL R I *E-16687, *E-17612
ONIZAWA S *B-19581
OPLADEN, H B *B-10993
OPPELT, W H F-01852
ORNING A A C-17419
ORNING, A A A-03113, *A-05011, A-05067, F-01852
OSHIO T *A-17199
OSOEGAWA I B-15251
OTOMURA K B-15693
OTTMERS D M JR *B-25416
OVERCAMP T J *B-24001
OZOLINS G *C-24245
OZOLINS, G *A-09737, *D-00858, L-01890, *M-00336

P

PACK D H *E-24569
PADOVANI C *B-16510, *K-22248
PAGLIARI M *B-22884
PALO, G P *A-07800
PALOWITCH, E R B-00276
PANFILOV G A *E-16687
PANFILOVA, G A E-10219
PANOFSKY, H A *E-07428
PARCZEWSKI W *E-13965
PARETSKY L *B-19834
PARKER W C *B-16250
PARKER, A *N-07845
PARRY V F *F-13601
PARRY, M *E-11514

PARSLY, L F B-04755
PARSONS, D D-11525
PATEL, H C I-04622
PAULSON C A J *B-23331
PAULUS, H J D-04116
PAVLUNIN V A *B-25217
PEARSON J L *B-21238
PEARSON, R B *B-09469
PECHKOVSKIY V V *B-13817, B-14057, *B-15946, B-19619
PECK, R E *A-02633
PELL M B-15284
PENNY G W *B-13674
PERANIO A *B-25298
PERELATOV V D *G-12289
PERRINE R L *A-26226, *A-26233, *B-26230
PERRY H *B-12253, *B-19471
PERRY, H *A-12541, *B-00564, *B-05454, *B-09666
PETERS W *B-23544
PETERS, W *B-02970, *B-11055
PETERSEN B G-14530
PETERSEN H *C-22511
PETERSON E K *E-15178
PETERSON H K *A-16887
PETERSON K R *E-21073
PETERSON M J *F-17592
PETERSON, D G B-00140
PETROLL, J *B-07674
PETROW H G *A-21351
PFEFFER R *B-12310, B-19834
PFEIFFER, J J *F-01852
PHILLEO, R E *B-08923
PHILLIPS A B *B-14322, *B-23221
PICHEL W *B-24290
PINAEV V A *B-15913
PLANTS, K D J-01707, *J-08867
PLUMLEY A L B-23140, B-24168
POLLACK L W *L-18220
POLLOCK W A *B-14137, *B-23822
POLLOCK, W A *B-03879, *B-07430
POOLER, F E-00023, E-04033, E-04034, E-04035
POOLER, F JR *E-00846
PORTEOUS A *B-17531
PORTER, R *H-01589, *L-01590
PORTERFIELD C W B-14001
POTAPENKO L S G-12289
POTTER E C *B-24630
POTTER, A E B-04842, *B-07466
POTTINGER J F *B-25207
POWELL J *A-12266, *A-24955
POWELL J R *A-23954
PRADEL Y *B-22671
PRASAD, B *E-07428
PREM, L L *A-09165
PRICE, J T *E-09417
PRIDATCHENKOV V G B-13817
PUBLIC HEALTH SERVICE *D-09591
PUBLIC HELATH SERVICE *A-09588
PURSGLOVE, J JR *N-07431
PUTNAM, B *L-10998

Q

QUACK R *B-22505
QUACK, R *J-02151
QUESNEL G *B-25677
QUIG R H *B-16731
QUITTER V *B-22501
QUITTER, V *B-07674

R

RAASK E *F-16883
RAASK, E *F-11163
RAE, S *G-07039
RAHN K A *C-25231
RAMSDEN A R *B-23331, *C-16734, *C-22909, *F-15714
RASSOW B *B-26155
RATCLIFFE, D B *A-10444
RATHGEBER F *B-26063
RAUSCHER J A *B-19480
RAWLANI P B *C-16364
RAYMOND L D *B-22792
RAYNER, H M *A-05169
READLING C L A-13963
REARDON W A *A-26085
RECORD F A E-21099
REDFEARN M W *C-22885
REDFEARN, M W *E-01259, *E-01260, *E-01261
REED L E *B-22110
REED, S K *B-08228, *L-06739
REES R L *A-24916, *B-13523, *B-15489, *B-19395
REESE J T B-13674, I-13086
REESE, J T *B-08863
REHMANN, C A-09737, *A-09737
REICHEL M A-25196
REID W T *A-13401, *B-25517, *F-13572
REID, W T *B-09999, *F-09967
REIDAT R *E-21122
REIN B D *L-18223
REMIREZ R *B-18034
RENZI P N *B-23027
RESHIDOV I K B-22661
RICE G A *I-13086
RICH, G R A-09075
RICHARD C *B-17672
RICKARD E K A-13141
RIEDEL F *B-24019
RIKHTER B V E-16687
RIKHTER, B V E-10219
RINALDI L *B-20738
RISSER, H E *A-09989
RITCHINGS, F A *A-11739
RIVERA CORDERO A *A-17483
ROBBINS J A C-25231
ROBERTS J J *E-19737, *E-25229, L-12461
ROBERTS, J J D-09984, E-11065
ROBINSON, E B *B-11178
ROBINSON, M E *A-07645
ROESNER G *B-24270, *B-24554
ROGAN, J M *G-07039
ROGERS, T F *B-01187
ROGGENDORF A *A-14378
ROGOFF, M H B-00222
ROHRMAN, F A A-00943, *A-01480, *A-01489, *A-01816, *A-07759, *A-07963
ROLFE, T J K B-12672
ROSE H J *B-13171
ROWE D R *C-24412
ROWSON, H M *B-08352
RUDORFF D W *B-17979
RYAN, J M *A-08393
RYLEY, M D *B-09600

S

SACHDEV R N *C-16364
SACKS, M E F-11782
SADLER, J W L-01890
SAGE, W L *B-05258
SAKAGISHI S *A-21191
SAKAI K *C-22391
SAKS, S Y *F-11722
SAKUMOTO Y B-14394
SALEEM A *B-25165
SALERNO, A A *B-11251
SALLEE E E A-25196
SALO E A *A-17051
SALTSMAN R D *B-14162
SALTSMAN, R D *B-11215
SANDERSON, H P *D-00657
SAPOZHNIKOV, A P G-11437
SAPPOK, R J *B-11131
SARKAR G G *A-13511
SARKAR M K *A-13511
SAWYERS, C H L-13049
SAX, J B-11191
SCAIOLA G *B-25427
SCHADE, G B-07674
SCHAFFER S G *A-11860
SCHAUFLER, E *B-10933
SCHEIDEL C *B-24756
SCHEIDEL, C F *B-11250
SCHIERMEIER F A *A-12335, *D-23957
SCHILDHAMMER, A *L-08062
SCHLACHTER D J *B-16068
SCHLESINGER, M D *A-08391
SCHMID, M R *F-11782
SCHMIDT, K R B-10933
SCHMITZ, F W B-09163
SCHNEIDER, G G *B-02036
SCHNITZLER H *C-22342
SCHNUERPEL W B-19692
SCHOENHERR D B-25269
SCHREITER W *B-19346
SCHROEDER M *B-19380
SCHUENEMAN, J J *A-02765
SCHUH U A-21286
SCHULDT, A F *B-03232
SCHULER R E *B-15516, J-15510
SCHULZ E J *C-26139
SCHULZ, E J *C-04040
SCHWARTZ, C H A-03113, A-05011, A-05067
SCHWARZ K *B-23757
SCHWARZ O *B-14546
SCHWARZ, K *B-02032
SCHWARZ, O *B-11005
SCHWITZGEBEL K B-25416
SCOLLON T R *J-19685
SCORER R S *E-16985
SCOTT, D *A-02634
SCRIVEN, R A *E-01934
SEABORG G T *A-18078
SEBASTIANI, E *B-10336
SEDOR P *B-19034
SEGLIN L A-13410
SEGUIN R L *F-14876
SEIDL W *A-14478, *B-20550
SEIFERT W *B-26237
SEKI M *B-24269
SEKI S *B-12417
SELICKAJA V I *E-20924
SELITSKAYA, I *E-10229
SEMENENKO N A *B-22986
SEMENOV V S *B-22986
SENSENBAUGH, J D B-00140
SENSHU T E-26141
SENYUSHKIN, N I *B-10264
SHAFER, H E JR *A-06978, *B-08936, *B-09904
SHALE C C *B-15532, *B-15543, *B-20485
SHALE, C C *B-01615, *B-10704, *F-09769
SHAMIRZAYEV, S Y *D-05260
SHANNON L J *A-25196
SHARMA L N E-14271
SHAVER R G *J-23800
SHEALEY, L D *B-13015
SHENFELD, L *B-00687
SHEPARD D S *B-24681
SHERIDAN E T *A-16212
SHERIDAN, E T A-03340
SHERWOOD T K *G-24021
SHERWOOD, P T *B-09600
SHIBLER B K *B-19733, *B-22809

AUTHOR INDEX

SHIDARA M *B-24207, *E-23163
SHILHAN M J B-15516
SHIMODA O *B-21643
SHIRASAWA T *A-17184, *B-17392, *B-23262
SHIRVAIKAR V V *E-14271
SHLIGERSKIY A S B-14057, B-15946, B-19619
SHORT, W *C-07848
SHRINER, R D *G-11828
SIEGMUND C W *B-15148
SIETH J *B-25637
SILVERMAN, L *N-01063
SILVERMAN, M P *B-00222
SIMON C *B-25187
SIMON J A *A-12202
SIMON, H *B-09788, *B-09789
SIMONS W H *B-21005
SIMONS, W H *B-11191
SIMPSON C L *E-24407
SINCAY A C S P DE *B-22702
SINGER J G *B-18167
SINGER T E R *B-22883
SINGER, I A *C-11340
SKAGGS, H C *B-08921
SKAPERDAS G T *B-12424
SKOPP A A-12619, B-22861, B-24678
SKRIVANEK J *B-17004, B-25494
SLACK A V *B-16425
SLACK, A V *B-08346, *B-08836, *B-11240
SLANSKY C M *A-16887
SLATER H H E-16285
SLAWSON P R *E-12353
SLAWSON, P R *E-07801
SLUTSKER, A S *C-08123
SMITH C M *B-13592
SMITH J F *C-17419
SMITH N S JR *C-25260
SMITH R W *A-21916
SMITH, D K *B-08939
SMITH, J F A-05011
SMITH, M C *B-11251
SMITH, M E *C-11340, E-06373, E-10421
SMITH, R D-05551, *M-00336
SMITH, W S *A-00532
SNOW R D *B-19373
SNYDER, M J *B-08919
SNYDERMAN J S F-14851
SOMERS, E V *B-02424, *B-09905
SOMMERLAD, R E *B-07515
SONDREAL, E A *A-02631
SOTGIA G *B-20738
SPAITE P W *A-15391, *A-24732, *B-19340, *B-21268, *L-19062
SPAITE, P W B-05310, B-07466, B-08429, *G-01865
SPALENY J *H-20982
SPEIZER F E *G-16837
SPENCER J D *A-22875
SPENCER, J D *B-02408
SPENGLER G *B-22740
SPENGLER, G *B-06999
SPERR F W JR *B-24458
SPICER T S *B-23867
SPINAZZOLA, A *D-08298
SPORN, P *B-01796
SPROULL, W T *B-04940
SPRUNK G C *F-13834
SPURR G *E-24341
SPURR, G E-03557, *L-02052
SQUIRES A M B-12310, *B-14207, *B-15240, *B-15284, *B-15738, B-19834, *B-20729, *B-20794, *B-21381
SQUIRES B J *B-20188
SQUIRES, A M *B-01493, *B-05338, *B-08908, *B-08917
SREENIVASAN T N F-22587
STABENOW, G *B-02398
STAIRMAND C J *B-16720
STALKER, W W *D-04116
STANKUS L *B-23880
STASTNY, E P *B-09496
STEIGERWALD, B J A-01480, A-01816, A-07759, A-07963
STEINBERG M *A-12266, *A-23954, *A-24955
STELLE W W *B-18045
STELLE, W W *B-13019
STEPANOVA A D G-12289
STEPHENS N T C-16875, *E-23409
STEPHENS, J F *C-07941
STEPHENS, J O A-04652
STERN, A C *L-01654, *N-06133
STEWART, R F *F-08941
STICKNEY, R E F-00105
STITES J G JR *B-14730, *B-16862
STITES, J G JR *B-11233
STOCKTON E J *C-23350
STONE G N *D-16237
STONE, G N *B-02311
STOUFF M L *F-13620
STRANGE T I B-25416
STRAT G L *A-22144
STRAUSS S D *F-13400
STRAUSS, W *B-10003
STREMBITSKIY A N *B-25217
STRIMBECK D C *A-19038
STRIMBECK G R B-15532, B-20485
STRIMBECK, D A-12541
STRONG, R E *A-09169
STRUCK R T B-17338
SUGDEN, F G *L-07950
SUGINO K B-21643
SULLIVAN R J *A-17688
SULLIVAN, K M *A-08641
SUPP A *B-19692
SURH, W C-03460
SUSSMAN, V H *B-02772, D-03432
SUZUKI J *F-17594
SUZUKI M *E-19503
SUZUKI, T *D-07951
SYED, E U B-07425
SZEPESI D *E-16629

T

TABOR E C C-24245
TAILOR, J P *B-05531
TAKAHASHI A *B-25702
TAKAHASHI K *A-17542
TAKENOUCHI H *F-16376
TAKESHITA K B-15692
TALDYKIN I A A-13261
TAMARUA Z *B-25071
TAMBURRINO, A E *B-03974
TAMORI Y B-23262
TANAKA K *B-13721, B-21643
TANAKA S *B-14394
TANAKA Y *A-13293
TANAKA, K D-07951
TANAKA, S *G-04136
TAUBMAN, A B *B-10165
TAYLOR W C *B-23140, *B-24168
TAYLOR, F W C-03460
TAYLOR, W G *B-08713, *B-10770
TEITELBAUM P D *A-13785
TELLER A J *B-15436
TELLER, A J *B-08342
TELLO Z J *A-26299
TENNESSEE VALLEY AUTHORIT *B-10681
TER LINDEN A J *A-24915
TERRANA J D *B-20696
TERRY S L *C-23121
THEILMANN P *B-25677
THEODORE F W *L-14598
THEODORE L *B-19834
THIEME, W *B-02974
THIESSEN R *A-18171
THOM, G W *B-03232
THOMAS F W *B-14159, *E-17580, *E-25815
THOMAS S *B-12443, *B-18290
THOMAS, F W A-00691, *C-02921, *E-00023, *E-04033, *E-04034, *E-04035, E-06373, *E-06823, E-10421
THOMPSON A P *B-19672, *B-22012, *B-24516
THORANDT K A-15246
THRING M W *A-16239
THURLOW G G *B-13950
TIEMAN J W *B-13570
TIGGES, A J *L-03277
TITOV N G *B-15244
TOMANY J P *B-14137, *B-23822
TOMANY, J P B-03879, *B-07430
TOMB T F *B-22792
TOYOFUKU, T G-04136
TSANG G *E-20523
TSAROS, C L A-08390
TSUDA M B-15841
TSUNEMOTO T B-15692
TSVETKOV, V P *G-11437
TSYBALYSKIY, B A *G-11437
TUENTGEN H *B-23544
TURNER L G B-12308
TURNER, B E-00023, E-04033, E-04034, E-04035
TYBOUT, R A *J-07643
TYRER D *B-19475, *B-19678, *B-19874, *B-22014

U

UENISHI Y B-23447
UHLANDER P H N B-21238
ULMER R C B-13639, B-14838
ULMER, R C *I-11286
UNDERWOOD G *B-23955
UNGAR E W C-26139
UNGAR, E W C-04040
UNGOED, W P C *B-07673
UNO T *B-16346, *B-24589
UNO, T *B-11252
UNTERBERGER O G *A-13330
USKOV, V I *B-06307
UTHE E E *E-15483
UZHOV, V N *B-08146
UZIMA, M *C-07721

V

VADOT L *B-15616
VAN DER HOVEN, I *E-10608
VAN DOORNUM G A W *B-12446
VAN DOORNUM, G A W *B-03053
VAN DUUREN H *B-16224
VAN HEEK K H *A-19444, *B-26084
VAN HEEK, K H F-10429
VANDEGRIFT E A *A-25196
VARJU G B-16496
VARSHAVSKII, T P *B-04634
VCELAK, V *C-11842
VEJVODA J *B-17318
VENEZIA, R *D-00858
VERROCHI, W A L-03277
VESTAL M L *F-14851
VETTER H *C-19047
VEVERKA *B-09607
VEVERKA V *B-11976

VIDALI, U G-01340
VILAND C K *A-17052
VINNIK I Y B-15665
VIOLET P *A-13855
VITTORI O *C-23096
VOEIKOV, A I *E-11370
VOGELY W A *A-14980, *N-13591
VOGELY, W A *A-07647
VOLOSHIN V G *E-16467
VORONOV F D *A-13261
VRATNY J *A-17280
VRONSKIY, A I *C-08123

W

WAGNER, H A *A-07644
WAGNER, R J *A-09161
WAHNSCHAFFE E *B-16240, *B-23718
WALKENHORST W *C-25872
WALKER A B *B-25047
WALKER F E *A-16256
WALKER, A B *F-04939
WALKER, F E *C-07516
WALKER, J B JR A-02630
WALKER, P L JR *B-11131
WALLIS G B *B-17531
WALLSOM H E *B-22070
WALPOLE, R H JR B-09546
WALSH, R T *A-09831, *B-09833
WALTERS, D F *A-01842, *D-01790
WALTERSCHEID E C *A-19318
WALTON, W H G-07039
WANG, T C A-09165
WARD A L *F-18185
WARD W J III *B-22615
WARNECK P E-21099
WARNECK, P E-11624
WASSER, J H JR *B-10680
WATANABE H *A-25914
WATERS, R F *B-06490
WATKINS E R *B-25833
WATSON, K S *B-02206
WEATHERLY, M L P M D-02057
WEAVER, D B *A-07800
WEAVER, R D *A-10183
WEBER E *E-25212
WEEKS, N E B-02424, B-09905
WEIN W *B-16863, *N-22794
WEISBURD, M I *B-00975
WELSH, G B *D-03431
WELSH, H W *F-11257
WENDER, I B-00222
WERNER R P *B-18167
WEYERS, W *B-01712
WHAITE, H M A-02860
WHELAN P F *F-13573
WHIRL S F *B-18063
WHITE, H F *L-06686
WHITE, H J *B-05868
WHITEHEAD C *B-25127
WHITEHOUSE A G R *B-13636
WIEDERSUM G C JR *B-24837
WILDER J E E-21099
WILEY R P *B-25560
WILLET H P *B-16681
WILLIAMS D F *B-20995
WILLIAMS D H JR *B-16815
WILLIAMS, J D *L-01890
WILLIAMSON, G V *B-11262
WILSON E B B-14838
WILSON E R *B-13639
WILSON, E B B-08898, B-13051, L-13049
WINCHESTER J W C-25231
WINKELSTEIN, W JR *G-11339
WINNACKER, K *B-08584
WITTMAIER, A J A-09161
WOHLERS H C *D-22812
WOLFGANG, H *B-11906
WOLKENBERG G *B-26237
WRIGHT, C H B-01187
WRIGHT, F D *F-13027
WRONSKI, W *L-01399

Y

YAMADA H B-16346, *B-24589
YAMADA T *B-23146
YAMADA, H B-11252
YAMAGUCHI N B-23447
YAMAMOTO Y *B-24269
YANDON, K E *B-02813
YANYSHEVA, N Y *G-07138, *L-10166
YASUDA K B-19581
YASUKAWA H E-17734
YATABE T B-21643
YELISEYEV V S *E-20163
YOCOM J E *A-14997
YOCOM, J E *I-07553
YOSHIMOCHI S *B-20262
YOUNG R D B-14322, B-23221
YOUNG S W *B-24253
YUILLE, W D B-04755

Z

ZABROSKE, T A *A-09539
ZAHRADNIK L *B-11996
ZAJONTZ J F-22319
ZAKIEVA, S K *B-10165
ZAWADZKI E A *B-11847, *B-15572
ZAWADZKI, E A B-01362
ZEDDA, S D-08298
ZENTGRAF K M *B-16872, *B-19048, *B-21504
ZENTGRAF, K M *B-08825
ZHAVORONKOV, N M *B-08470
ZHILIN P N *D-22591
ZIELKE C W *B-17338
ZIMMER, F V *B-08922
ZIMMERMAN, R E *B-00567
ZIMMERMANN, L B-07674
ZLATIN, L E B-04634
ZOLOTAREV, K V B-04634
ZOLTAN F B-15976
ZUBIK B *B-20563

SUBJECT INDEX

A

ABATEMENT A-16073, A-19434, A-21221, A-24500, A-26299, B-06697, B-08378, B-11906, B-11910, B-25187, C-24412, D-09591, D-09984, D-11525, E-11065, J-08059, J-11111, J-16174, K-21896, L-07950, L-08062, L-09474, L-11185, L-11781, L-12461, L-13055, L-18223, L-21431, L-24214, L-26157, M-08072, N-23125
ABSORPTION A-12619, A-13494, A-16722, A-26226, B-00135, B-02053, B-03337, B-03581, B-04842, B-06543, B-07417, B-07430, B-08347, B-08836, B-08908, B-09607, B-09833, B-09904, B-10336, B-11247, B-11252, B-11253, B-11256, B-16279, B-16731, B-16851, B-19261, B-19471, B-21238, B-21506, B-24678, B-25184, B-25786, C-00945, C-11193, C-21663, D-02979, E-25212, F-00530, F-14851, F-16376, F-18185, J-17203, J-26193, L-06686, L-24033, M-25143
ABSORPTION (GENERAL) A-14574, A-25062, B-00135, B-00140, B-02053, B-02407, B-02908, B-02970, B-02971, B-03045, B-03337, B-03581, B-04655, B-04791, B-06345, B-06999, B-08342, B-08346, B-08347, B-08371, B-08470, B-08574, B-08584, B-08836, B-09607, B-09833, B-09999, B-10591, B-10681, B-11055, B-11159, B-11250, B-11252, B-11253, B-11256, B-11262, B-11906, B-11976, B-12234, B-12503, B-12581, B-13394, B-13569, B-13721, B-13767, B-13817, B-13829, B-14137, B-14269, B-14566, B-15357, B-15436, B-15489, B-15844, B-15902, B-15962, B-15976, B-16173, B-16425, B-16500, B-16681, B-16731, B-16872, B-16968, B-17004, B-17685, B-17979, B-18154, B-19380, B-19395, B-19471, B-19482, B-19581, B-19608, B-19629, B-19670, B-20035, B-20141, B-20552, B-20663, B-20914, B-21200, B-21720, B-21893, B-22103, B-22291, B-22327, B-22615, B-22740, B-22756, B-22883, B-23054, B-23221, B-23373, B-23504, B-23718, B-23773, B-23822, B-23880, B-24048, B-24441, B-24673, B-24707, B-24985, B-25165, B-25416, B-25494, B-25503, B-25560, B-25584, B-25743, B-25913, B-26230, D-22591, F-13487, F-16376, G-24021, J-16129, J-17203, L-09443, L-11283, L-19062, L-24033
ACETONE B-08352
ACETYLENES A-10424, A-16877, H-05420
ACID SMUTS A-06040, A-23044, A-24817, A-25062, A-25549, B-02149, B-10399, B-17250, B-20082, L-07950
ACIDS A-00972, A-05011, A-05067, A-09686, A-09737, A-10740, A-12633, A-15517, A-16788, A-17464, A-19017, A-21204, A-21221, A-22875, A-23044, A-24817, A-25062, A-25549, A-26226, B-00135, B-00975, B-01362, B-01727, B-02195, B-02407, B-02442, B-02727, B-02931, B-02971, B-03337, B-03581, B-05198, B-06999, B-07931, B-08155, B-08342, B-08346, B-08584, B-08836, B-08863, B-09191, B-09469, B-09607, B-09789, B-09833, B-09996, B-10281, B-10591, B-10680, B-10968, B-11055, B-11131, B-11159, B-11233, B-11238, B-11247, B-11250, B-11253, B-11256, B-11281, B-11906, B-12092, B-13592, B-14087, B-14546, B-14730, B-15031, B-15092, B-15436, B-15976, B-16851, B-16862, B-16863, B-18034, B-19394, B-19480, B-19608, B-19733, B-20082, B-21232, B-21643, B-22057, B-22110, B-22160, B-22441, B-22702, B-22740, B-22809, B-22905, B-23027, B-23054, B-23221, B-23231, B-23544, B-23718, B-23867, B-23880, B-24142, B-24207, B-24441, B-24643, B-24673, B-24756, B-25038, B-25071, B-25088, B-25127, B-25494, B-25503, B-25584, B-25637, B-25702, B-25743, B-26084, B-26211, B-26230, C-03592, C-07482, D-01790, D-04116, D-05260, D-06819, D-09591, D-22812, E-10153, E-10751, E-16985, E-24486, F-00530, F-10429, G-01865, G-07138, G-08232, G-16837, G-18109, H-02299, H-05420, H-06967, I-07553, I-20820, J-00166, J-01659, J-01707, J-08059, J-08867, J-11846, J-17203, K-02010, K-06778, L-00311, L-01890, L-10998, L-11242, L-11283, L-17472, L-18223, L-24033, N-04212, N-21360, N-22794
ACROLEIN A-16722
ACUTE G-20700, I-20820
ADHESIVES B-25186, B-25269
ADMINISTRATION A-01480, A-01842, A-02501, A-02765, A-03587, A-04333, A-06040, A-07963, A-08391, A-09539, A-09737, A-10743, A-11619, A-12619, A-13292, A-13316, A-16073, A-16949, A-17398, A-18078, A-19434, A-21191, A-22800, A-24915, A-25196, A-26299, B-00975, B-01796, B-02192, B-04506, B-04507, B-05529, B-06345, B-06636, B-07075, B-08347, B-08348, B-08863, B-08917, B-09789, B-09996, B-11178, B-11910, B-13051, B-13057, B-13813, B-14159, B-14270, B-14546, B-14707, B-15544, B-16731, B-18110, B-20563, B-21381, B-21819, B-22861, B-23176, B-23237, B-23708, B-23880, B-24142, B-24826, B-25038, B-25165, B-25187, C-23350, C-24245, C-25147, D-00657, D-00858, D-01790, D-02818, D-03431, D-03432, D-03514, D-05010, D-06755, D-06777, D-07393, D-07951, D-09591, D-09984, D-11525, D-12496, E-07428, E-08400, E-10153, E-10368, E-25815, G-01340, G-01865, G-02417, G-07039, G-08230, G-11300, G-18109, H-01589, H-06967, J-00166, J-00253, J-01546, J-01679, J-08059, J-11111, J-16506, L-00206, L-01265, L-01585, L-01590, L-01890, L-02052, L-02960, L-03277, L-03359, L-03452, L-05105, L-05499, L-06188, L-06615, L-06686, L-07550, L-07950, L-08062, L-08686, L-09073, L-09443, L-09445, L-09474, L-11319, L-11526, L-12461, L-14535, L-17321, L-19062, L-24214, L-25688, L-26157, M-00336, M-01567, M-08072, M-22636, N-00164, N-03344, N-05194, N-07845, N-14816, N-18206
ADSORPTION A-12619, A-13494, A-15620, A-16722, B-00135, B-01245, B-02970, B-03337, B-03581, B-04842, B-08352, B-08584, B-08836, B-09833, B-10493, B-11910, B-13636, B-14632, B-16851, B-24643, B-24678, B-26084, B-26220, C-21663, E-10608, E-24569, F-13766
ADSORPTION (GENERAL) A-14574, B-13243, B-13578, B-13829, B-14269, B-14546, B-14566, B-14632, B-14660, B-15378, B-15913, B-16425, B-19189, B-21200, B-22505, B-22740, B-22905, B-23544, B-24207, B-24269, B-24837, B-25071, B-25702, B-26230, G-24021, K-21896, L-14535
ADULTS D-06755, G-04136, G-07138, G-11437, G-16837
ADVECTION E-20042, E-25229
ADVISORY SERVICES K-09921, L-09073, L-17006
AERODYNAMICS B-10704, B-21136, E-09417, F-11722, F-17594
AEROSOL GENERATORS B-03974, B-04755, B-08713, B-09833, B-10993, C-04040
AEROSOLS A-23170, A-25213, B-00107, B-00135, B-00975, B-04516, B-04755, B-07515, B-08155, B-08371, B-09833, B-15841, B-19834, B-26063, C-01354, C-09624, C-16875, C-17468, C-18012, C-21663, D-02979, D-05010, E-05702, E-16467, E-16803, F-00530, F-11722, F-24272, G-01865, G-07138, G-20700, G-21276, H-02299, J-01546, L-00311, N-00164
AFRICA A-00532, A-01480, A-02501, A-07759, A-08388, B-00140, B-00205, B-00276, B-00544, B-00564, B-00567, B-00568, B-01362, B-01493, B-02053, B-02408, B-02424, B-02727, B-02813, B-02931, B-03337, B-07931, B-12443, B-12446, B-15560, B-18290, B-24681, D-01790, E-00023, F-00530, F-01852, F-02743, G-01865, J-01659, J-01660, J-02413, L-01590, L-02960, L-11242
AFTERBURNERS A-26233, B-04506, B-20073, B-20243, B-21232, J-01546, J-21241, L-08062
AGE G-11339
AIR CONDITIONING EQUIPMENT F-01379
AIR POLLUTION EPISODES A-06040, A-09353, A-16855, D-07393, D-11525, E-24486, E-25075, F-00530, G-06826,

G-16837, G-18109, G-21276, G-23670, L-02960, L-03359, L-03452, L-09073, L-12461, L-17321, N-21289

AIR POLLUTION FORECASTING A-17483, B-04200, B-21819, C-01856, D-06777, D-11525, E-07428, E-10220, E-13965, E-19737, E-21099, E-25229, H-06967, L-02960, L-12461

AIR QUALITY CRITERIA A-11739, A-25418, D-09591, L-06188, L-07950, L-08686, L-18121

AIR QUALITY MEASUREMENT PROGRAMS A-02765, A-03587, A-09737, A-11619, A-12619, A-16073, A-17398, A-25196, B-01796, B-23708, B-25187, C-23350, C-24245, C-25147, D-00657, D-00858, D-01790, D-02818, D-03431, D-03432, D-03514, D-05010, D-06755, D-06777, D-07393, D-07951, D-09591, D-09984, D-12496, E-07428, E-08400, E-10153, G-02417, G-07039, G-08230, H-01589, L-01890, L-02052, L-02960, L-03277, L-03359, L-03452, L-06188, L-07950, L-08686, L-09445, L-12461, L-24214, L-25688, M-00336, N-00164, N-14816, N-18206

AIR QUALITY MEASUREMENTS A-00532, A-00943, A-00972, A-01350, A-01510, A-02630, A-02631, A-03113, A-06040, A-06351, A-06978, A-07570, A-09161, A-09737, A-09831, A-10183, A-10284, A-10424, A-10678, A-10754, A-11988, A-12202, A-13855, A-14997, A-15246, A-16073, A-16212, A-16788, A-17051, A-17398, A-17688, A-21286, A-22867, A-24005, A-25213, A-25418, A-25545, A-25975, B-00975, B-01485, B-01796, B-04842, B-04940, B-05258, B-05868, B-06278, B-06697, B-07359, B-08713, B-08919, B-08937, B-08939, B-09496, B-09600, B-09833, B-10770, B-13394, B-18290, B-22871, B-23757, B-25207, B-25584, C-01857, C-03546, C-04040, C-04889, C-07721, C-09624, C-11193, C-14733, C-15348, C-16860, C-23096, C-24412, C-25231, C-26139, D-00657, D-02046, D-02057, D-02818, D-02953, D-03431, D-03432, D-03514, D-04116, D-05010, D-05260, D-05428, D-05551, D-06755, D-06819, D-07393, D-07951, D-08858, D-09591, D-09984, D-10723, D-11525, D-13176, D-16237, D-22591, D-22812, D-23326, D-23356, D-25476, E-00023, E-01259, E-01260, E-06827, E-07428, E-07580, E-08400, E-10010, E-11065, E-16687, E-16803, E-21099, E-21736, E-21986, E-25212, F-00530, F-01852, F-07059, F-08943, F-09064, F-09769, F-14851, G-01865, G-07138, G-08230, G-11828, G-21276, G-23151, J-01308, J-01660, J-11111, L-00206, L-00311, L-00973, L-01265, L-01654, L-01890, L-02011, L-02052, L-03277, L-03359, L-05499, L-06188, L-07950, L-09445, L-11266, L-18220, L-25688, N-00164, N-02632, N-04432, N-21289

AIR QUALITY STANDARDS A-03587, A-10442, A-13219, A-16855, A-16887, A-19434, A-19994, A-21916, A-24500, A-25549, A-25975, B-00975, B-02032, B-02424, B-06999, B-09833, B-10493, B-20854, B-24985, C-05216, D-01790, D-02818, D-02953, D-02979, D-06819, D-07141, D-09591, E-10153, E-11370, E-23163, G-02417, G-08232, G-24021, J-02151, J-08059, K-06696, K-06778, L-00206, L-00311, L-00973, L-01654, L-01890, L-06188, L-07794, L-09474, L-10166, L-11266, L-18220, L-24214, N-21289, N-21360

AIR RESOURCE MANAGEMENT A-14997, E-10368, E-19737, L-06188, L-18220, L-26157

AIR-FUEL RATIO A-15620, A-16410, B-11191, B-22071, B-25677, I-04622

AIRCRAFT A-00972, A-10754, A-16073, A-25259, A-25549, B-10680, B-12672, B-15544, C-09624, C-15479, C-16875, C-18012, D-09591, D-12496, E-00023, E-10421, E-11065, J-13613, L-00311, L-03359, M-25143, N-00164, N-17819

ALABAMA A-01489, B-08925, C-07516, D-03431, L-11185, L-11781

ALASKA C-07516, E-24109, E-24439

ALCOHOLS B-08352, B-12503, C-23121, E-07580, G-07138

ALDEHYDES A-00532, A-00972, A-01842, A-03113, A-05011, A-05067, A-09686, A-10754, A-16722, B-00975, B-06636, B-08080, C-03592, C-21663, D-00858, D-03514, D-05010, D-22812, N-04212

ALERTS A-06040, L-02960, L-12461

ALFALFA B-08938

ALIPHATIC HYDROCARBONS A-00532, A-08390, A-08391, A-09831, A-10424, A-16877, A-17017, B-03337, B-04179, B-05857, B-06543, B-06636, B-08352, B-09195, B-13636, B-19373, B-25503, C-11842, F-10422, F-10429, F-13766, F-22319, F-22587, H-00316, H-02299, H-05420

ALKALINE ADDITIVES A-14478, A-14574, A-22800, A-23044, A-24817, A-24978, A-25867, B-00135, B-00140, B-00205, B-00544, B-01362, B-02149, B-03337, B-03581, B-03879, B-04200, B-04655, B-04842, B-05198, B-05454, B-06136, B-07430, B-07466, B-08346, B-08347, B-08429, B-08574, B-08825, B-08836, B-08863, B-09666, B-09833, B-09999, B-10681, B-10968, B-11055, B-11159, B-11178, B-11240, B-11847, B-11854, B-11910, B-12308, B-12574, B-12581, B-12645, B-12797, B-13569, B-13721, B-13767, B-14057, B-14137, B-14162, B-14207, B-14660, B-15148, B-15358, B-15436, B-15489, B-15572, B-15841, B-15946, B-16248, B-16250, B-16282, B-16418, B-16425, B-16548, B-16731, B-16851, B-16872, B-17004, B-17124, B-17318, B-17905, B-18110, B-18154, B-19339, B-19394, B-19471, B-19608, B-19619, B-19845, B-19972, B-20392, B-20425, B-20539, B-20696, B-20995, B-21028, B-21238, B-21268, B-21275, B-21504, B-21643, B-22057, B-22160, B-22809, B-22961, B-23140, B-23315, B-23708, B-23718, B-23822, B-23879, B-23880, B-24048, B-24207, B-24253, B-24565, B-24613, B-24678, B-24697, B-24707, B-24985, B-25165, B-25416, B-25517, B-25602, B-25787, B-26211, B-26230, C-16860, F-00530, G-24021, J-08867, L-06737, L-09443, L-11319, L-11526, L-14535, L-19062, L-24033

ALKALIZED ALUMINA (ADSORPTION) B-00135, B-00140, B-01362, B-01726, B-01727, B-02195, B-02407, B-02778, B-02908, B-04200, B-04655, B-05454, B-06136, B-06278, B-06345, B-06636, B-07417, B-08342, B-08346, B-08347, B-08574, B-08836, B-09666, B-09971, B-09999, B-10968, B-11159, B-11247, B-11910, B-12091, B-12253, B-12503, B-12645, B-13501, B-13829, B-13856, B-14087, B-14162, B-14269, B-14566, B-14981, B-15436, B-16418, B-16425, B-16851, B-16872, B-17124, B-18110, B-18154, B-19471, B-20550, B-21005, B-23315, B-23373, B-24207, B-24707, B-24837, B-25517, B-25584, F-00530, G-01865, J-01707, J-08867, L-01590, L-08686, L-09443, L-11283, L-11319, L-11526, L-14535, L-19062

ALLERGIES F-00530, G-07138, G-08230

ALPHA PARTICLES A-02860

ALTITUDE A-01510, A-12335, A-17280, A-25213, B-00687, B-01796, B-15616, B-22051, B-22500, B-22884, B-24001, B-24985, B-25298, C-01856, C-02668, C-18012, C-22885, C-23377, D-02953, D-02979, D-06777, D-08858, D-16237, D-23356, D-23957, E-00846, E-01260, E-01261, E-01934, E-03251, E-03557, E-05702, E-06373, E-06775, E-06823, E-07843, E-10010, E-10220, E-10229, E-10368, E-10608, E-10751, E-11980, E-13965, E-16467, E-16629, E-16687, E-16985, E-17595, E-17725, E-17734, E-20042, E-20924, E-21073, E-21099, E-21122, E-21736, E-21986, E-22313, E-23163, E-24109, E-24407, E-24486, E-24569, E-26141, E-26267, L-01890, L-02052, N-03344, N-07845

ALUMINUM A-09686, B-00107, B-09788, B-21324, F-14512, L-08062, N-07431

ALUMINUM COMPOUNDS A-09831, B-03337, B-03581, B-08574, B-09600, B-09971, B-22103, B-24048, B-24142, B-24270, B-25743, B-25744, F-04827, F-09769, N-07431

ALUMINUM OXIDES B-05868, B-08574, B-08919, B-08937, B-08939, B-08942, B-09788, B-09833, B-14566, B-25744, C-25872, F-08943, F-11163, N-04432, N-07431

ALVEOLI F-00530

AMIDES B-08352

AMINES B-03337, B-03581, B-12503, B-16500, B-24048

AMMONIA A-00972, A-09686, A-13978, A-25213, B-02206, B-03337, B-03974, B-04634, B-05198, B-08346, B-08470, B-08836, B-08863, B-09607, B-09833, B-10591, B-10692, B-11910, B-11976, B-12574, B-15489, B-15902, B-19373, B-21643, B-22740, B-23773, B-25038, B-25079, B-25207, B-25743, B-26211, C-06095, D-03514, D-05010, D-05428, D-07393, D-22812, F-11257, N-04212

AMMONIUM COMPOUNDS A-00972, A-09686, A-13978, A-25213, B-02206, B-03337, B-03581, B-03974, B-04634, B-05198, B-08346, B-08470, B-08836, B-08863, B-09607, B-09833, B-10281, B-10591, B-10692, B-11252, B-11910, B-11976, B-12503, B-12574, B-14087, B-14261, B-14322, B-15489, B-15902, B-16968, B-19373, B-19394, B-19482, B-19629, B-21643, B-22160, B-22441, B-22740, B-22809, B-23146, B-23221, B-23305, B-23447, B-23773, B-24048, B-24589, B-25038, B-25079, B-25207, B-25702, B-25743, B-26211, C-06095, D-03514, D-05010, D-05428, D-07393, D-22812, F-11257, H-06967, N-04212

ANALYTICAL METHODS A-02631, A-02860, A-03113, A-05067, A-07570, A-10183, A-10424, A-10444, A-13494, A-13848, A-14997, A-15620, A-16256, A-18114, A-21383, A-21999, A-22144, A-22875, A-23884, B-00135, B-00975, B-02407, B-02408, B-02442, B-04755, B-06999, B-08825, B-09904, B-13394, B-15436, B-22740, B-24837, B-25913, C-00886, C-00945, C-03592, C-07482, C-07516, C-07941, C-11755, C-11842, C-12126, C-13477, C-16149, C-17419, C-17468, C-20224, C-21663, C-22342, C-22391, C-22885, C-22982, C-23096, C-24412, C-25231, D-02979, D-07951, D-22812, D-23326, E-07580, E-10010, E-11624, E-21099, F-00530, F-08941, F-10429, F-11135, F-11163, F-16376, F-17592, G-01865, G-08230, I-07553, I-20820, L-01890, L-03277, L-03452, L-08062, L-08686

ANEMIA G-07138

ANEMOMETERS E-26141

ANIMALS A-21999, B-06999, D-02818, F-00530, G-01865, G-04136, G-08232, G-11300, G-11828, G-21276, H-02299, H-06967, I-20820, J-00166, L-00311, L-03359, L-03452, N-04212

ANNUAL A-07645, A-07647, A-09737, A-10754, D-01790, D-07393, D-07951, D-08858, E-11065, J-11114, L-01890, L-09445, L-25688

ANTHRACENES A-10424, C-00945

ANTICYCLONES D-09591, E-10220, E-11514, G-21276

ANTIMONY COMPOUNDS A-05067, A-06351, K-02010, K-06778

APPLES H-05420

AREA EMISSION ALLOCATIONS L-01890

AREA SURVEYS A-02765, A-03587, A-09737, A-11619, A-12619, A-16073, A-17398, A-25196, B-01796, C-23350, D-00657, D-00858, D-01790, D-02818, D-03431, D-03432, D-03514, D-05010, D-06755, D-06777, D-07393, D-07951, D-09591, D-12496, E-07428, E-08400, G-02417, H-01589, L-01890, L-03277, L-03359, L-03452, L-09445, L-12461, M-00336, N-00164, N-14816, N-18206

ARIZONA C-07516, C-16875, M-01220, M-01221

ARKANSAS A-01489, C-07516, K-00167, L-08062, M-01221

AROMATIC HYDROCARBONS A-10424, A-13494, A-16877, B-02813, B-08352, F-10422, K-00167

ARSENIC COMPOUNDS A-11988, A-13219, A-17688, A-22875, A-25545, B-00975, B-08155, B-09833, B-11238, K-02010, K-06778, L-24214, N-04212

ARSINE B-00975

ASBESTOS B-09788, C-01363

ASHES A-00532, A-02630, A-02631, A-02633, A-02634, A-02860, A-05169, A-08641, A-09161, A-09831, A-11411, A-13401, A-13644, A-16949, A-19017, A-19038, A-19318, A-22387, A-24005, A-25545, A-25689, B-00272, B-00568, B-02032, B-04634, B-05198, B-05258, B-06835, B-07229, B-08080, B-08085, B-08146, B-08155, B-08348, B-08836, B-08863, B-08870, B-08936, B-09833, B-09923, B-10692, B-10704, B-10770, B-11005, B-11191, B-13057, B-13983, B-14001, B-15031, B-18142, B-18161, B-22981, B-25269, B-25744, C-00403, C-05216, E-21986, F-01852, F-09769, F-09967, F-11163, F-13572, F-17592, G-12289, I-11286, I-13086, J-00253, L-00311, L-06686, L-07550, L-08062, L-10166, M-08072, N-04212, N-04432

ASIA A-06040, A-07759, A-13293, A-13644, A-15620, A-17184, A-17199, A-17398, A-17542, A-21191, A-24500, A-24508, A-24535, A-24817, A-25062, A-25690, A-25914, B-02149, B-04655, B-10563, B-10692, B-11252, B-12417, B-12442, B-13721, B-14087, B-14194, B-14261, B-14394, B-15092, B-15251, B-15692, B-15693, B-15738, B-15841, B-15844, B-16346, B-16548, B-16872, E-17250, B-17343, B-17392, B-19581, B-19972, B-20097, B-20262, B-20392, B-20526, B-21275, B-21324, B-21643, B-22160, B-22291, B-22981, B-23146, B-23262, B-23447, B-24207, B-24269, B-24589, B-24643, B-24673, B-24707, B-24826, B-25019, B-25071, B-25088, B-25284, B-25298, B-25702, C-07482, C-07721, C-12126, C-16149, C-16364, C-16512, C-17468, C-22391, D-05428, D-07393, D-07951, D-10723, E-14271, E-17595, E-17725, E-17734, E-19503, E-20068, E-23163, E-24391, E-26141, F-00530, F-10422, F-16376, F-17594, F-24272, G-16837, G-23151, I-03222, L-09445, L-09474, L-11242, L-24214, M-25143, N-04212, N-13591

ASPHALT A-00972, A-09686, A-11860, B-00107, B-08922, D-05260, D-09591, J-16174, L-08062, N-07431

ASTHMA F-00530, G-23151, L-03359, N-21360

ATMOSPHERIC MOVEMENTS A-00691, A-01510, A-01842, A-10678, A-16073, A-16887, A-22159, A-24500, B-00140, B-00687, B-00975, B-01796, B-04200, B-06835, B-20550, B-22051, B-22500, B-22884, B-23974, B-25298, C-01856, C-02668, C-04040, C-09624, C-11340, C-15925, C-16149, C-16364, C-22511, C-23350, C-26139, D-02046, D-02818, D-02979, D-03431, D-03514, D-05010, D-06777, D-08858, D-09591, D-09984, D-10723, D-11525, D-23356, E-00023, E-00846, E-01259, E-01260, E-01261, E-02410, E-03251, E-03557, E-04033, E-04034, E-04035, E-05357, E-05702, E-06373, E-06775, E-06823, E-07428, E-07843, E-08400, E-10010, E-10053, E-10153, E-10219, E-10220, E-10229, E-10421, E-10608, E-10751, E-11065, E-11370, E-11514, E-11980, E-13965, E-14271, E-15483, E-16629, E-16687, E-16803, E-17580, E-17595, E-17734, E-19503, E-19737, E-20042, E-20924, E-21736, E-21986, E-22313, E-23163, E-23723, E-24109, E-24341, E-24391, E-24407, E-24486, E-25212, E-25229, E-25815, F-01379, F-11257, G-00981, G-21276, L-01265, L-01654, L-01890, L-03277, L-08686, L-09445, L-11266, L-11383, L-25688, L-26157, N-04212

ATTACK RATES G-04136, G-07138, G-08230

AUSTRALIA A-08388, A-08641, A-10424, B-01493, B-02408, B-02424, B-05516, B-18142, B-23331, B-24630, B-25207, C-07941, C-16734, C-22909, E-24243, F-15714, J-01659

AUTOCLAVES B-11910

AUTOMATIC METHODS B-00975, D-06755, F-08941, L-08686

AUTOMOBILES A-09353, A-09686, A-14997, A-15620, A-18052, A-19434, A-25418, B-00975, B-04506, B-08352, B-08584, B-10493, B-18110, B-21819, C-00886, D-00858, D-05428, D-07393, D-12496, E-24439, E-25075, J-01546, J-16174, L-00206, L-01585, L-03359, L-05499, L-06188, L-07550, L-08062, L-09073, L-17472, L-24214, M-00336, N-00164, N-04212, N-21287, N-21289, N-23125

AUTOMOTIVE EMISSION CONTROL A-15620, A-16410, A-17910, A-18052, A-26226, B-04506, B-11191, B-15544, B-18110, B-21819, B-22071, B-25427, B-25677, G-11828, I-04622, J-15889, L-01265, N-01063

AUTOMOTIVE EMISSIONS A-00972, A-09353, A-09686, A-10424, A-10442, A-12619, A-15620, A-16722, A-16877, A-25418, A-26226, B-00975, B-04506, B-06636, B-08080, B-08584, B-10493, B-15544, B-15933, B-18110, B-19261, B-21819, C-24412, D-03431, D-03432, D-05260, D-05428, D-06755, D-07393, D-08298, D-12496, D-22812, E-23723, E-24439, E-25075, F-00530, G-11828, G-16192, G-21276, H-01398, H-05420, H-07786, J-01546, J-16174, L-00311, L-00973, L-01890, L-09445, L-17472, L-24214, M-00336, N-00164, N-01063, N-04212, N-07845, N-21287, N-21289, N-23125

B

BACTERIA B-00222, B-02149, B-07425, D-22812

BAFFLES B-05163, B-07385, B-07416, B-16720, B-20738, B-22001, B-22756, B-25663, C-21663, E-09417, J-01308

BAG FILTERS A-04778, A-04937, B-00107, B-00140, B-04508, B-04516, B-05163, B-05310, B-07075, B-07385, B-07416, B-07515, B-08155, B-09788, B-09833, B-16720, B-21324, B-22057, B-23315, B-23955, B-24837, B-24881, B-24985, D-05260, J-01308, L-08062

BALLOONS A-00691, B-22884, E-03557, E-04033, E-10053, E-10421, E-11065, E-26141

BANDING H-05420

BARIUM COMPOUNDS A-05067, A-06351, B-10770

BASIC OXYGEN FURNACES A-03587, A-09686, A-09737, B-03232, J-01546

BELGIUM A-03587, A-16855, A-17910, D-07393, D-23326, G-16837, L-00311, L-17006

BENZENE-SOLUBLE ORGANIC MATTER D-05010, L-05499, L-09445

BENZENES A-10424, B-02813, B-08352, F-10422

BENZO(3-4)PYRENE A-00972, A-02549, A-05011, A-05067, A-07570, A-10424, A-10754, A-16877, A-23884, A-25545, A-25549, C-00945, D-00858, D-07393, N-04212, N-21289

BENZOPYRENES A-00972, A-02549, A-05011, A-05067, A-07570, A-10424, A-10754, A-16877, A-23884, A-25545, A-25549, C-00945, D-00858, D-07393, N-04212, N-21289

BERYLLIOSIS A-00532, A-00943, A-00972, A-01510, A-02014, A-02549, A-02860, A-03113, B-00135, B-00140, B-00564, B-00975, B-01485, B-01712, B-01796, B-01866, B-02311, B-02407, B-02408, B-02778, B-03045, B-03232, C-00403, C-00886, C-00945, C-01354, C-01363, C-01856, C-01857, C-02655, C-02668, C-02921, C-03460, C-03546, C-03592, C-04040, D-00657, D-02046, D-02057, D-02818, D-02953, D-02979, D-03432, D-03514, E-00023, E-01259, E-01260, E-01261, E-03557, E-04033, E-04034, E-06775, F-01852, F-02743, G-00981, G-02417, J-01659, J-01660, K-00167, L-00206, L-00311, L-00973, L-01890, L-03277, L-03359, L-03452, N-00164

BERYLLIUM B-08492, D-07951, D-09591, H-00316

BERYLLIUM COMPOUNDS A-05067, A-06351, B-08492, B-11996, D-07951, D-09591, H-00316, N-04212

BESSEMER CONVERTERS A-09686

BETA PARTICLES C-19519, E-05702

BIOCLIMATOLOGY F-00530

BIOMEDICAL TECHNIQUES AND MEASUREMENT C-11842, D-02818, D-06755, E-10153, F-00530, G-00981, G-01340, G-04136, G-07039, G-07138, G-08230, G-08232, G-11339, L-11266

BIRMINGHAM,GREAT BRITAIN B-13636, B-25127, F-13766

BISMUTH D-09591

BISMUTH COMPOUNDS A-06351, D-09591

BLAST FURNACES A-03587, A-09686, A-09737, B-07931, B-12417, B-16681, B-20243, D-00657, D-13176, K-02010

BLENDING A-07759, A-09161, B-08917, B-22160, L-11185

BLOWBY N-00164

BODY CONSTITUENTS AND PARTS C-01857, F-00530, G-01865, G-04136, G-07138, G-08230, G-08232, G-11339, G-11437

BODY PROCESSES AND FUNCTIONS B-10680, B-10704, D-06755, E-10608, F-00530, G-04136, G-06806, G-08230, G-08232, G-11300, L-11266

BOILERS A-02630, A-02631, A-02633, A-02634, A-03113, A-04224, A-04778, A-05011, A-05067, A-05169, A-05846, A-08641, A-09161, A-09539, A-09831, A-10743, A 11640, A-11739, A-11968, A-12120, A-12541, A-13832, A-13855, A-16410, A-16949, A-17017, A-18052, A-19017, A-24005, A-24732, B-00107, B-00140, B-00272, B-00276, B-00544, B-00687, B-01485, B-01493, B-02032, B-02206, B-02398, B-03045, B-03053, B-03879, B-03974, B-04200, B-04516, B-05198, B-05508, B-05853, B-05857, B-05868, B-06697, B-07075, B-07229, B-07359, B-07430, B-07673, B-07752, B-07962, B-08155, B-08346, B-08348, B-08825, B-08836, B-09191, B-09469, B-09546, B-09666, B-09833, B-09905, B-09923, B-10993, B-11178, B-11240, B-11247, B-11251, B-11253, B-11256, B-12040, B-12308, B-12446, B-12574, B-12581, B-12672, B-13501, B-13639, B-13857, B-13950, B-14194, B-14838, B-15378, B-15544, B-15560, B-15572, B-15665, B-16068, B-16502, B-17343, B-17782, B-17905, B-18154, B-18167, B-18290, B-18296, B-19034, B-19642, B-19972, B-20035, B-20063, B-20082, B-20097, B-20243, B-20539, B-20563, B-20854, B-21200, B-21268, B-21313, B-21506, B-21720, B-21893, B-22070, B-22071, B-22291, B-22671, B-23176, B-23220, B-23674, B-24073, B-24480, B-24613, B-24642, B-24675, B-24678, B-24697, B-24837, B-25079, B-25637, B-25744, B-25786, B-25833, C-00403, C-03460, C-07787, C-07848, C-09107, C-22342, D-05260, D-07141, D-11525, F-04939, F-09967, F-13487, F-16883, I-04622, I-11286, J-01308, J-21241, K-06778, K-09921, L-07550, L-07950, L-09445, L-09474, L-20698

BORON COMPOUNDS A-06351, B-08938, B-11996

BRICKS B-08926, B-08936, B-09469, B-09788, B-09904, F-14876, I-07553, N-07431

BROMINE E-24109

BROMINE COMPOUNDS B-00975

BRONCHI G-07138, G-18109, G-20700

BRONCHITIS D-02818, E-25075, F-00530, G-00981, G-07138, G-08230, G-12289, G-16837, G-18109, G-20700, G-23151, G-24021, L-03359, N-21360

BRONCHOCONSTRICTION G-18109, G-20700

BROWNIAN MOVEMENT B-19834

BUBBLE TOWERS B-00140, B-08155, B-11252, B-20696, B-24048

BUDGETS J-01546, J-16506, L-00206, L-08062, L-11319, L-11526, L-19062, L-25688

BUILD-UP RATES B-23757

BUILDINGS B-08938, B-09699, C-11340, D-11525, E-10608, E-10751, F-01379, F-01380, J-07643, L-00206, L-01399, L-11266, N-17819

BUSES B-00975, B-04506, C-00886, D-00858, D-05428, L-09073, M-00336, N-00164

BUTADIENES A-10424

BUTANES A-10424, C-11842

BUTENES A-10424, B-06636

BY-PRODUCT RECOVERY A-02634, A-03072, A-06978, A-13410, A-16949, A-19318, A-21204, A-25062, A-25689, B-03232, B-03337, B-03974, B-04655, B-05490, B-06999, B-07417, B-07673, B-08342, B-08346, B-08347, B-08352, B-08492, B-08836, B-08908, B-08917, B-09600, B-09607, B-09666, B-09833, B-09996, B-11005, B-11131, B-11233, B-11238, B-11247, B-11250, B-11252, B-11281, B-11906, B-11910, B-11985, B-11996, B-12092, B-12417, B-12503, B-13052, B-13523, B-13592, B-13663, B-13767, B-13813, B-14087, B-14159, B-14162, B-14207, B-14261, B-14566, B-15031, B-15240, B-15251, B-15284, B-15436, B-15489, B-15841, B-15902, B-15976, B-16173, B-16425, B-16510, B-16681, B-16731, B-16851, B-17004, B-17685, B-18154, B-19394, B-19395, B-19480, B-19482, B-19560, B-19602, B-19608, B-19733, B-19874, B-19876, B-20223, B-20262, B-20526, B-20552, B-20663, B-20696, B-20914, B-21005, B-21643, B-22001, B-22012, B-22014, B-22057, B-22103, B-22160, B-22175, B-22279, B-22441, B-22702, B-22883, B-22981, B-23054, B-23140, B-23221, B-23231, B-23315, B-23374, B-23447, B-23504, B-23526, B-23708, B-23718, B-23773, B-23867, B-23880, B-24019, B-24142, B-24168, B-24207, B-24253, B-24270, B-24397, B-24516, B-24554, B-24565, B-24589, B-24613, B-24673, B-24756, B-24777, B-25038, B-25071, B-25165, B-25170, B-25269, B-25320, B-25323, B-25494, B-25517, B-25702, B-25743, B-25744, B-25787, B-25795, B-25913, B-25973, B-26063, B-26211, B-26230, F-18170, J-01546, J-08867, J-11846, J-15510, J-16129, J-17203, J-25961, L-06739, L-10998, L-11242, L-11283, L-13055, L-14598, L-19062, L-24033, N-02632, N-07431

C

CABBAGE H-20982

CADMIUM D-07951, D-09591

CADMIUM COMPOUNDS A-05067, D-07951, D-09591, K-02010, K-06778, L-24214, N-04212

CALCIUM COMPOUNDS A-09831, A-13401, A-24978, B-00135, B-00544, B-03337, B-03581, B-03879, B-04842, B-08346, B-08574, B-08825, B-08908, B-08939, B-09191, B-09600, B-09833, B-10681, B-10770, B-11055, B-11854, B-12672, B-12797, B-13569, B-13817, B-15244, B-15692, B-16731, B-19339, B-19340, B-19619, B-22809, B-23027, B-23526, B-23544, B-23822, B-24613, B-24697, B-25416, B-25430, B-25584, F-04827, F-04939, F-08943, F-09967, F-11163, F-16376, I-11286, J-08867, N-04432

CALCIUM SULFATES B-00135, B-08346, B-09833, B-10681, B-19340, B-22809, B-24613, B-24697, B-25430, F-08943

CALIBRATION METHODS A-19084, B-08825, C-04040, C-11755, C-19047, C-22342, E-04033, F-10429

CALIFORNIA B-00107, B-00975, B-04516, B-09833, B-21594, C-07516, D-07393, E-02410, E-23723, H-05420, L-00311, L-00973, L-01585, L-06188, L-09443, L-11266, L-18223, N-00164, N-04212

CAMERAS A-00691

CANADA A-00532, A-00691, A-01510, A-02631, A-02633, A-02634, A-06351, A-07759, A-08388, B-00975, B-01245, B-01796, B-01866, B-03974, B-04179, B-22175, B-25165, C-01354, C-01857, C-04040, C-15515, E-00023, E-03557, E-04033, E-07801, E-10053, E-12353, F-00530, G-16837, H-07786, L-01265, L-02960, L-05499, L-11242, L-11266, M-22636

CANCER A-17688, A-19994, A-21999, D-03432, E-25075, G-11339, G-23670, G-24021, L-03359, N-21289

CARBON BLACK A-08392, A-09103, A-09831, A-10424, A-22875, B-01245, B-03581, B-05868, B-08085, B-08836, B-08937, B-09788, B-09789, B-10770, B-11131, B-20188, B-22110, B-25071, C-07848, F-08941, F-09769, F-10422, F-11782

CARBON DIOXIDE A-00532, A-02501, A-03113, A-05067, A-08641, A-09103, A-09831, A-10678, A-12266, A-13848, A-13855, A-14478, A-17357, A-19318, A-19994, A-21383, A-23619, B-00975, B-02778, B-02908, B-04200, B-08825, B-13636, B-16279, B-18111, B-18296, B-19373, B-19378, B-19471, B-19672, B-20073, B-22615, B-23376, B-23526, B-24270, B-24480, B-25416, B-25494, B-25913, B-26155, C-04889, C-11755, C-11842, C-16734, C-16860, D-05428, D-22812, E-15178, E-24109, E-25212, F-01852 F-10422, F-10429, F-11163, F-13766, G-20700, I-07553, K-22248, L-00311, N-04212, N-22794

CARBON DISULFIDE B-03337, B-06543, B-08352, B-11910, B-13829, B-19876, B-24458, B-26155, B-26211, H-06967, L-00311

CARBON MONOXIDE A-00532, A-00972, A-01842, A-02549, A-03113, A-05011, A-05067, A-08391, A-09103, A-09353, A-09686, A-09737, A-10442, A-10754, A-12266, A-14997, A-16073, A-17017, A-17357, B-00107, B-00975, B-03337, B-03581, B-04200, B-04506, B-06636, B-07075, B-08080, B-08825, B-09666, B-09833, B-10493, B-10993, B-11131, B-11191, B-12040, B-13394, B-13636, B-16681, B-18110, B-19261, B-19373, B-19475, B-19541, B-19672, B-20073, B-20425, B-21819, B-22012, B-23374, B-24270, B-24397, B-25416, B-25427, B-26155, C-00886, C-11193, C-11842, C-21663, D-00858, D-01790, D-02818, D-05010, D-05260, D-05428, D-09591, D-12496, D-22812, E-07580, E-23723, E-25075, F-10422, F-10429, F-22319, G-11828, G-12289, G-20700, G-21276, H-02299, H-05420, H-06967, J-01546, J-15889, J-16174, J-21241, K-22248, L-01654, L-01890, L-03359, L-06188, L-06730, L-08062, L-09445, L-09474, L-17472, L-24214, M-00336, N-00164, N-04212, N-07845, N-21287, N-21289, N-21360

CARBONATES A-23359, A-24978, B-00544, B-03232, B-03581, B-03879, B-09833, B-11055, B-11191, B-12797, B-19619, B-22327, B-22756, B-22868, B-22869, B-22871, B-23374, B-23376, B-23526, B-23544, B-23773, B-23822, B-25494, B-25913, B-26084, C-13477, F-08943, G-24021, I-07553, N-04432

CARBONYLS B-07962, B-11131, B-13829

CARBOXYHEMOGLOBIN G-21276

CARBURETOR EVAPORATION LOSSES L-01890

CARCINOGENS A-00943, A-00972, A-01350, A-01489, A-01510, A-01842, A-02014, A-02860, A-03113, A-07570, A-10424, B-00975, B-01362, B-01485, B-01712, B-01796, B-04200, C-00945, C-01856, C-01857, C-02668, C-03546, C-04040, D-00657, D-02046, D-02057, D-03432, D-03514, E-00023, E-01259, E-01260, E-01261, E-03251, E-03557, E-04033, E-04034, F-00530, G-00981, G-01865, K-02010, L-00206, L-00311, L-00973, L-01654, L-01890, L-02011, L-02052, L-03277, L-03359, N-00164

CARDIOVASCULAR DISEASES A-21999, G-21276, L-11266

CASCADE SAMPLERS B-00975, C-00886, C-04040, C-26139

CATALYSIS A-00972, A-05011, A-12619, A-15620, A-16788, A-22875, A-26226, B-00135, B-00140, B-00205, B-01727, B-02407, B-02970, B-03581, B-08080, B-08346, B-08429, B-09833, B-10336, B-10591, B-10680, B-10692, B-11910, B-11929, B-12234, B-13569, B-15092, B-15692, B-19378, B-19541, B-19876, B-20035, B-21200, B-21232, B-21506, B-22012, B-22740, B-22905, B-23176, B-23374, B-23526, B-23880, B-24253, B-24270, B-24565, B-24678, B-24922, B-25088, B-25320, B-25323, B-25787, B-25973, G-18109, J-00166, J-01707, K-00167

CATALYSTS A-15620, A-22875, B-01727, B-02407, B-02970, B-03581, B-08346, B-09833, B-10591, B-10680, B-10692, B-11910, B-11929, B-12234, B-13569, B-15692, B-19378, B-19541, B-19876, B-21232, B-21506, B-22012, B-22740, B-24253, B-24565, B-25088, B-25320, B-25323, B-25787, B-25973, J-00166, J-01707, K-00167

CATALYTIC ACTIVITY A-00972, A-12619, A-26226, B-00135, B-00140, B-00205, B-02970, B-03581, B-08429, B-09833, B-10692, B-15092, B-21232, B-21506, B-23374, B-23526, B-24922, G-18109, J-00166, J-01707

CATALYTIC AFTERBURNERS B-04506, B-21232

CATALYTIC OXIDATION A-14574, A-16788, A-19017, A-22875, B-00140, B-01727, B-02195, B-02727, B-02970, B-03337, B-04200, B-04506, B-04655, B-05454, B-06999, B-08342, B-08346, B-08347, B-08429, B-08836, B-09666, B-09999, B-10336, B-10968, B-11131, B-11159, B-11233, B-11253, B-11256, B-11262, B-11910, B-12092, B-12253, B-13243, B-13767, B-13856, B-14087, B-14162, B-14261, B-14566, B-14730, B-15031, B-15092, B-15148, B-15436, B-16240, B-16418, B-16425, B-16851, B-16862, B-17004, B-17124, B-18034, B-18154, B-19395, B-19471, B-19480, B-19560, B-19876, B-20035, B-21200, B-21232, B-21720, B-22057, B-22740, B-22905, B-23315, B-23718, B-23879, B-23880, B-24207, B-24837, B-24922, B-24985, B-25088, B-25165, B-25517, B-25584, B-25743, B-26230, G-24021, J-08867, J-15889, J-26193, K-00167, L-08686, L-09443, L-19062, M-25193

CELLS F-00530, G-18109

CEMENTS A-00972, A-08392, A-09737, A-21221, A-25213, B-02036, B-04940, B-06062, B-07931, B-08919, B-08922, B-08923, B-08937, B-08939, B-09469, B-09600, B-09788, B-09789, B-09833, B-09904, B-12417, B-15251, B-16720, B-20188, B-24881, E-10368, J-15889, J-16174, J-17203, L-08062, N-07431, N-21287

CENTRIFUGAL SEPARATORS A-02634, A-03113, A-03587, A-05067, A-09686, A-23359, B-04200, B-04655, B-05163, B-05853, B-05868, B-07385, B-07416, B-07674, B-08146, B-08348, B-08378, B-08870, B-08921, B-09163, B-09191, B-09546, B-09833, B-12442, B-13569, B-13983, B-16720, B-18154, B-19724, B-20243, B-20854, B-21117, B-21886, B-22070, B-22401, B-22501, B-22505, B-22671, B-22792, B-22986, B-23305, B-24609, B-24642, B-24756, B-24881, B-25019, B-25323, B-25973, C-07787, C-07848, C-21663, D-05260, J-21241, L-02960, L-03277, L-06686, L-09474

CERAMICS A-09686, B-00107, B-09788

CERIUM COMPOUNDS B-19876

CHAMBER PROCESSING B-11906

CHARCOAL A-08392, A-14574, A-25062, B-03337, B-04755, B-08342, B-08346, B-08352, B-08371, B-08584, B-08836, B-11131, B-11250, B-11910, B-14566, B-14632, B-19581, B-22702, B-24269, B-26155, B-26220, F-00530, F-10422, F-13766, G-11300, J-08867, L-06739

CHEMICAL COMPOSITION A-02630, A-02631, A-06351, A-06978, A-09161, A-09831, A-12202, A-16212, A-24005, A-25545, B-04842, B-04940, B-05258, B-05868, B-06278, B-06697, B-08919, B-08937, B-08939, B-09600, B-22871, B-25207, C-23096, C-25231, D-05010, D-25476, E-06827, F-01852, F-08943, F-09064, F-09769, F-14851, J-01660, L-05499, L-09445, N-02632, N-04432

CHEMICAL METHODS A-10183, A-13494, A-21999, B-00135, B-02407, B-02408, B-02442, B-06999, B-24837, B-25913, C-07482, C-07516, C-11842, C-12126, C-17419, C-22885, D-22812, F-16376, F-17592, G-08230

CHEMICAL PROCESSING A-00972, A-02765, A-07644, A-07759, A-07963, A-08392, A-08393, A-09686, A-09737, A-12088, A-12633, A-14400, A-14701, A-15517, A-16722, A-17199, A-17398, A-17464, A-21221, A-23044, A-24500, A-25196, A-25213, A-26226, B-00107, B-00975, B-02053, B-02192, B-02931, B-02971, B-03581, B-04634, B-06490, B-07931, B-08155, B-08342, B-08584, B-09195, B-09789, B-09833, B-10591, B-10968, B-11238, B-11250, B-11906, B-11910, B-14660, B-15844, B-16681, B-16720, B-16851, B-17318, B-18111, B-19733, B-20188, B-21232, B-21594, B-21819, B-23447, B-24142, B-24643, B-24673, B-25019, B-25047, B-25139, B-25913, C-04889, C-16875, C-17468, C-21663, D-00858, D-04116, D-09591, D-12496, D-13176, D-22591, E-10751, F-18185, G-01865, G-07138, G-11828, G-16192, G-16837, H-02299, H-06967, H-07786, I-07553, I-20820, J-00166, J-01546, J-08059, J-11111, J-16174, J-17203, J-21241, J-26193, K-02010, K-06778, L-00311, L-01890, L-06730, L-08062, L-08686, L-10998, L-11242, L-11266, L-11526, L-19062, L-21431, L-24033, L-24214, M-00336, N-21287

CHEMICAL REACTIONS A-05011, A-07793, A-08390, A-0839[illegible], A-10754, A-12619, A-13494, A-13978, A-16788, A-16877, A-19017, A-19444, A-22875, A-23170, A-25108, A-25213, A-26226, B-00135, B-00140, B-00205, B-00222, B-00564, B-01245, B-01727, B-01799, B-02442, B-02970, B-03337, B-03581, B-04791, B-04842, B-06543, B-06636, B-07425, B-07466, B-08228, B-08429, B-08470, B-08492, B-08574, B-09195, B-09666, B-09833, B-10336, B-10591, B-10680, B-10681, B-10692, B-11252, B-11906, B-11910, B-12234, B-12581, B-13817, B-15693, B-16282, B-16500, B-19189, B-19373, B-19378, B-19380, B-19471, B-19475, B-19541, B-19560, B-19672, B-19678, B-19874, B-20539, B-20696, B-20914, B-21234, B-22001, B-22012, B-22014, B-22279, B-22327, B-22702, B-22740, B-22869, B-22905, B-22961, B-22981, B-23176, B-23374, B-23526, B-23773, B-23880, B-24048, B-24253, B-24270, B-24397, B-24516,

B-24554, B-24565, B-24643, B-24673, B-24678, B-24777, B-24922, B-25088, B-25184, B-25320, B-25323, B-25430, B-25503, B-25787, B-25795, B-25973, B-26084, B-26155, C-02921, C-04040, C-11842, C-24412, C-26139, E-00023, E-10608, E-11624, E-25212, F-08943, F-09967, F-10422, F-10429, F-11782, F-14851, F-16376, F-16883, F-18185, F-22319, F-22587, G-21276, H-02299, H-05420, H-07786, I-04622, I-11286, J-01707, K-00167, L-00206, M-25188, N-07845
CHICAGO A-09539, D-09984, D-11525, E-11065, E-19737, E-25229, K-00167, L-00973, L-05105, L-06188, L-09443, L-11266, L-12461, L-17321, L-18121, L-26157, N-21360
CHILDREN D-06755, D-22591, G-07138, G-11437, G-12289, G-16837
CHLORIDES A-17464, B-09833, B-11238, B-23027, B-25416, C-23096, D-03514, D-05010, E-21986, K-02010, L-24033
CHLORINE A-06351, A-09686, A-19434, A-22875, B-03045, B-06543, B-06636, B-15693, D-22812, E-24109, G-07138, H-05420, K-02010, K-06778, L-00311, L-24033
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CITIZENS GROUPS B-00975
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COAL TARS A-10424, A-13410, A-25549, B-02813, B-02974, B-03053, B-04634, B-06835, B-17318, F-13601

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COLLECTORS A-00532, A-00972, A-01350, A-02634, A-03113, A-03587, A-05011, A-05067, A-09686, A-13832, A-23359, A-24915, A-25062, A-26233, B-00140, B-00272, B-00653, B-01712, B-01796, B-02149, B-02398, B-02909, B-03045, B-04200, B-04655, B-04755, B-05163, B-05853, B-05868, B-06835, B-07359, B-07385, B-07416, B-07515, B-07674, B-08085, B-08146, B-08155, B-08348, B-08378, B-08836, B-08863, B-08870, B-08921, B-09163, B-09191, B-09546, B-09699, B-09833, B-09923, B-10003, B-10165, B-10681, B-10933, B-11233, B-11251, B-11262, B-12442, B-13057, B-13569, B-13857, B-13983, B-14707, B-15031, B-16068, B-16224, B-16346, B-16720, B-17318, B-18034, B-18154, B-18161, B-18290, B-19692, B-19724, B-20188, B-20243, B-20738, B-20854, B-21117, B-21324, B-21886, B-22001, B-22070, B-22401, B-22501, B-22505, B-22560, B-22671, B-22756, B-22792, B-22986, B-23220, B-23305, B-24190, B-24609, B-24642, B-24756, B-24826, B-24881, B-24954, B-25019, B-25323, B-25517, B-25584, B-25663, B-25973, B-26143, C-01856, C-02921, C-04040, C-07721, C-07787, C-07848, C-09107, C-21663, D-01790, D-05260, D-22591, E-09417, J-01308, J-01546, J-21241, J-26193, K-09921, L-02960, L-03277, L-06686, L-07794, L-08062, L-09474, L-17472

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COLUMN CHROMATOGRAPHY C-00945, C-11842

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COMMERCIAL AREAS A-07647, A-08393, D-02057, D-07393, D-07951, D-09591, D-11525, E-06775, E-17725, L-01399, L-07550, L-09474, M-00336
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COMPUTER PROGRAMS A-00691, A-14997, A-23170, A-25418, B-01796, B-07075, B-10993, B-25416, C-01856, C-20224, D-09984, D-11525, E-04033, E-06373, E-10421, E-11065, E-16629, F-01379, F-22319, J-15889, L-01890, L-12461
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CONDENSATION (ATMOSPHERIC) A-01510, A-10678, A-22159, B-10680, B-17531, C-15925, D-08858, E-01261, E-06827, E-08400, E-10608, E-16803, E-16985, E-20924, E-21099, E-23723, E-24109, E-24439, E-24486, F-01379, G-00981, G-08230, G-08232, G-16837, G-18109, H-02299, N-04212
CONING E-21122
CONNECTICUT A-14997
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CONTACT PROCESSING A-12633, B-07931, B-11906, B-14660, G-07138, L-24033
CONTINUOUS AIR MONITORING PROGRAM (CAMP) L-01890
CONTINUOUS MONITORING A-01510, A-15620, A-19084, B-06999, B-07359, B-16240, B-25323, B-25637, C-04889, C-15479, C-17468, C-22885, C-23350, C-25260, D-02046, D-08858, E-08400, E-17734, E-21099, E-25212, F-08941, G-08230, L-08686, L-09445, L-17472, L-17473
CONTRACTING A-09539, L-01590
CONTROL AGENCIES A-16073, A-19434, B-11910, B-23708, B-23880, K-06696, L-07550, L-07794, L-09445, L-17472, M-00336, N-07845
CONTROL EQUIPMENT A-00532, A-00972, A-01350, A-02634, A-03113, A-03587, A-04224, A-04652, A-04778, A-04937, A-05011, A-05067, A-08392, A-09686, A-11411, A-11413, A-11640, A-11988, A-12619, A-13141, A-13410, A-13832, A-15391, A-15620, A-17688, A-19994, A-21204, A-23044, A-23359, A-23379, A-24915, A-24916, A-24951, A-24978, A-25062, A-25196, A-25867, A-26226, A-26233, B-00107, B-00135, B-00140, B-00205, B-00272, B-00564, B-00653, B-00975, B-01187, B-01362, B-01485, B-01493, B-01615, B-01712, B-01796, B-02032, B-02036, B-02053, B-02149, B-02192, B-02206, B-02311, B-02398, B-02407, B-02408, B-02727, B-02778, B-02909, B-02971, B-03045, B-03232, B-03337, B-03879, B-04179, B-04200, B-04506, B-04508, B-04516, B-04634, B-04655, B-04755, B-04791, B-04940, B-05163, B-05198, B-05310, B-05508, B-05531, B-05853, B-05868, B-06062, B-06307, B-06543, B-06697, B-06835, B-06999, B-07075, B-07229, B-07359, B-07385, B-07416, B-07425, B-07430, B-07466, B-07515, B-07674, B-07752, B-07931, B-08085, B-08146, B-08155, B-08342, B-08346, B-08348, B-08378, B-08429, B-08470, B-08492, B-08584, B-08836, B-08863, B-08870, B-08921, B-09163, B-09191, B-09496, B-09523, B-09546, B-09607, B-09666, B-09699, B-09788, B-09789, B-09833, B-09904, B-09923, B-09999, B-10003, B-10165, B-10264, B-10493, B-10655, B-10681, B-10692, B-10704, B-10933, B-10993, B-11005, B-11159, B-11229, B-11233, B-11238, B-11251, B-11252, B-11253, B-11256, B-11262, B-11910, B-11996, B-12040, B-12091, B-12234, B-12310, B-12442, B-12503, B-12574, B-12581, B-13015, B-13057, B-13394, B-13569, B-13570, B-13674, B-13767, B-13856, B-13857, B-13983, B-14137, B-14159, B-14162, B-14194, B-14207, B-14223, B-14269, B-14270, B-14294, B-14322, B-14473, B-14632, B-14707, B-14730, B-15031, B-15155, B-15378, B-15436, B-15489, B-15532, B-15543, B-15572, B-15665, B-15902, B-16068, B-16224, B-16248, B-16250, B-16282, B-16346, B-16496, B-16500, B-16681, B-16720, B-16731, B-16862, B-16872, B-16968, B-17004, B-17124, B-17318, B-17343, B-17531, B-17672, B-17905, B-17979, B-18034, B-18110, B-18142, B-18143, B-18154, B-18161, B-18290, B-19029, B-19261, B-19340, B-19380, B-19394, B-19471, B-19541, B-19608, B-19692, B-19724, B-19803, B-19834, B-19845, B-20035, B-20073, B-20097, B-20141, B-20188, B-20243, B-20392, B-20437, B-20485, B-20526, B-20696, B-20738, B-20779, B-20854, B-20914, B-21117, B-21136, B-21200, B-21232, B-21238, B-21268, B-21313, B-21324, B-21381, B-21720, B-21819, B-21886, B-22001, B-22057, B-22070, B-22071, B-22160, B-22291, B-22327, B-22401, B-22501, B-22505, B-22552, B-22560, B-22615, B-22661, B-22671, B-22702, B-22756, B-22792, B-22868, B-22869, B-22871, B-22986, B-23027, B-23140, B-23146, B-23176, B-23220, B-23221, B-23231, B-23262, B-23305, B-23315, B-23331, B-23374, B-23376, B-23504, B-23674, B-23682, B-23708, B-23773, B-23822, B-23879, B-23880, B-23955, B-24048, B-24168, B-24181, B-24190, B-24290, B-24441, B-24589, B-24609, B-24613, B-24630, B-24642, B-24673, B-24675, B-24678, B-24697, B-24707, B-24756, B-24826, B-24837, B-24881, B-24954, B-24985, B-25019, B-25047, B-25079, B-25127, B-25139, B-25164, B-25165, B-25170, B-25184, B-25207, B-25217, B-25269, B-25320, B-25323, B-25416, B-25427, B-25517, B-25584, B-25602, B-25663, B-25743, B-25786, B-25795, B-25833, B-25973, B-26063, B-26143, B-26211, B-26237, C-01354, C-01363, C-01856, C-01857, C-02921, C-04040, C-07721, C-07787, C-07848, C-08123, C-09107, C-21663, C-22342, C-22391, C-22882, C-23096, D-01790, D-02818, D-05260, D-06755, D-07951, D-22591, D-22812, D-23356, E-09417,

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CONTROL METHODS A-00532, A-01480, A-01489, A-02014, A-02501, A-02633, A-02634, A-03072, A-03587, A-04778, A-04937, A-05011, A-05067, A-06040, A-06978, A-07642, A-07759, A-08390, A-08391, A-08392, A-09103, A-09161, A-09686, A-09831, A-10442, A-10743, A-11739, A-11790, A-11968, A-11982, A-12266, A-12619, A-13141, A-13330, A-13410, A-13494, A-13511, A-13855, A-14400, A-14478, A-14574, A-15391, A-15517, A-15620, A-16410, A-16722, A-16788, A-16887, A-16949, A-17418, A-17483, A-17910, A-18052, A-18114, A-18177, A-19017, A-19038, A-19318, A-19511, A-21191, A-21204, A-22649, A-22800, A-22875, A-23044, A-23359, A-23379, A-23884, A-24535, A-24817, A-24916, A-24955, A-24978, A-25062, A-25689, A-25690, A-25867, A-26226, B-00107, B-00135, B-00140, B-00205, B-00222, B-00276, B-00544, B-00564, B-00567, B-00568, B-00687, B-00975, B-01187, B-01245, B-01362, B-01493, B-01712, B-01726, B-01727, B-01796, B-01799, B-01866, B-02036, B-02053, B-02149, B-02192, B-02195, B-02311, B-02398, B-02407, B-02408, 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L-14535, L-14598, L-17006, L-18223, L-19062, L-20698, L-24033, M-01567, M-08072, M-25143, M-25193, N-01063, N-02632, N-03344, N-07431, N-21289, N-21360, N-23125
CONTROL PROGRAMS A-01480, A-02501, A-02765, A-04333, A-07963, A-10743, A-19434, A-21191, A-22800, A-26299, B-00975, B-02192, B-14159, B-14270, D-03432, D-11525, E-10153, E-10368, G-18109, H-06967, J-00253, J-01546, J-01679, J-11111, L-00206, L-01265, L-01585, L-01590, L-01890, L-02052, L-02960, L-03452, L-05105, L-05499, L-06615, L-07950, L-08062, L-08686, L-09073, L-09443, L-09474, L-11319, L-11526, L-12461, L-14535, L-17321, L-24214, L-25688, M-00336, M-01567, N-03344, N-18206
CONTROLLED ATMOSPHERES C-21663, D-22812
CONVECTION B-09469, B-09833
CONVECTION (ATMOSPHERIC) E-13965, E-24109
COOLING A-07644, B-07673, B-07931, B-08836, B-09607, B-09833, B-12581, B-19541, B-19560, B-19670, B-21200, B-24001, B-24785, B-25088, B-25323, E-24109, E-24439, F-01379, F-01380, F-11163, N-13513
COPPER A-09686, B-00107, B-11906, B-24697, D-07951, D-09591, H-00316, I-07553
COPPER ALLOYS B-00107, B-24697
COPPER COMPOUNDS A-05067, A-06351, A-09831, A-21383, B-02407, B-03337, B-08347, B-14566, B-24253, B-25503, D-07951, D-09591
CORE OVENS B-00107, B-19733, I-07553
CORN B-08938
CORONA B-01615, B-04940, B-05868, B-08348, B-09789, B-10704, B-11929, B-15532, B-15543, B-22560, B-25207, C-01354, C-01857, F-09769
CORROSION A-19017, A-21999, A-23359, A-24005, B-03337, B-03974, B-05853, B-06999, B-07466, B-08085, B-08836, B-09191, B-09607, B-09833, B-10680, B-10681, B-12581, B-13639, B-14394,

B-14838, B-15572, B-16863, B-18296, B-20082, B-21643, B-22110, B-22327, B-22740, B-23376, B-24697, B-25637, B-25677, F-14876, F-16883, G-08232, I-04622, I-07553, I-11286, I-13086, I-20820, J-00166, L-11266, N-22794

COSTS A-02501, A-04778, A-05530, A-07642, A-07644, A-07645, A-07647, A-07759, A-08388, A-08390, A-08391, A-08393, A-09075, A-09194, A-09539, A-10442, A-11739, A-11789, A-12088, A-12285, A-13292, A-13316, A-13479, A-13515, A-13832, A-15517, A-16489, A-16492, A-16887, A-18078, A-18176, A-19024, A-19511, A-19994, A-21221, A-22649, A-22800, A-22875, A-23379, A-23954, A-24951, A-24955, A-25418, A-25689, B-00140, B-00205, B-00564, B-00567, B-00568, B-00687, B-01245, B-01362, B-01493, B-01726, B-01727, B-02036, B-02195, B-02407, B-02424, B-02727, B-02778, B-02909, B-03879, B-04200, B-04506, B-04508, B-04791, B-05198, B-05338, B-05454, B-06136, B-06345, B-07075, B-07229, B-07430, B-07515, B-07673, B-07752, B-08080, B-08342, B-08346, B-08378, B-08470, B-08825, B-08836, B-08863, B-08908, B-08917, B-08926, B-09607, B-09666, B-09699, B-09789, B-09833, B-09905, B-09971, B-09999, B-10281, B-10655, B-10681, B-10968, B-11233, B-11238, B-11240, B-11247, B-11250, B-11281, B-11847, B-11910, B-12040, B-12091, B-12253, B-12424, B-12581, B-12645, B-13171, B-13501, B-13592, B-13674, B-13829, B-14001, B-14137, B-14194, B-14261, B-14269, B-14730, B-15240, B-15489, B-15516, B-15572, B-15738, B-16173, B-16248, B-16282, B-16418, B-16681, B-16720, B-16746, B-16815, B-16851, B-16862, B-16872, B-18034, B-18063, B-18143, B-19048, B-19340, B-19394, B-19803, B-20082, B-20141, B-20425, B-20552, B-20794, B-20854, B-20914, B-21381, B-21504, B-21720, B-21893, B-22868, B-22869, B-23054, B-23220, B-23315, B-23373, B-23708, B-23757, B-23867, B-23880, B-23955, B-24073, B-24181, B-24589, B-24609, B-24613, B-24678, B-24681, B-24697, B-24707, B-24881, B-24954, B-24985, B-25047, B-25127, B-25427, B-25503, B-25584, B-26143, C-22885, D-09984, D-11525, E-11065, F-01379, F-01380, F-02743, F-11257, F-11782, F-13191, F-13487, F-16210, F-18170, G-01340, G-11828, G-24021, H-06967, H-11733, J-00166, J-00253, J-00978, J-01308, J-01546, J-01659, J-01660, J-01679, J-01707, J-02151, J-02413, J-02918, J-07643, J-08059, J-08867, J-11111, J-11114, J-11846, J-12418, J-15510, J-15889, J-16122, J-16129, J-16174, J-16506, J-17203, J-19685, J-20054, J-21241, J-23800, J-25961, J-26193, K-00167, L-00206, L-01585, L-01654, L-01890, L-06686, L-06735, L-06737, L-06739, L-07794, L-08062, L-08686, L-09073, L-10503, L-10998, L-11185, L-11266, L-11283, L-11781, L-12461, L-13055, L-14598, L-19062, L-21431, L-25688, M-01220, M-01221, M-01567, M-08072, N-01063, N-03344, N-05194, N-13513, N-18206, N-21360, N-23125

COTTON H-05420

COTTONS A-17688, B-07515, B-09788, I-07553

COUGH G-18109, L-11266

COUNTY GOVERNMENTS B-00107, L-08062, L-09443

CRACKING I-07553, I-20820

CRANKCASE EMISSIONS L-01890, N-00164

CRANKCASE VENTILATION AIR L-01890

CRITERIA A-04778, A-05506, A-05530, A-11739, A-13494, A-14980, A-16410, A-17051, A-25418, A-26299, B-02398, B-04791, B-10493, B-12040, B-13394, B-13501, B-13578, B-13584, B-13592, B-13829, B-14269, B-14294, B-14322, B-22792, D-09591, F-01379, F-01380, F-04939, F-13572, F-13573, F-13601, G-24021, K-22248, L-00973, L-01265, L-06188, L-07950, L-08686, L-13055, L-18121, N-05194, N-13587, N-13591

CROPS B-08938, B-09788, H-00316, H-02293, H-02299, H-05420, N-00164

CRYSTAL STRUCTURE A-13494, B-26084, E-24109, E-24439, F-04827, F-13573

CUMULATIVE METHODS B-02311, C-00886, D-00657, D-02818, D-06755, E-03251, E-25815, G-00981, G-02417, G-21276, L-03277, L-09445

CUPOLAS A-09737, B-00107, B-05531, B-16681, L-07950

CYANIDES B-25744, C-23096, L-24214

CYCLONES (ATMOSPHERIC) E-10220

CZECHOSLOVAKIA A-00691, A-02631, A-11981, A-11982, A-11988, A-13219, A-14701, A-17280, A-25545, B-00544, B-00687, B-00975, B-01796, B-01866, B-02032, B-03879, B-08492, B-09607, B-11976, B-11985, B-11996, B-13243, B-14707, B-17004, B-17318, B-19482, B-22961, B-25494, C-00945, C-01363, C-01856, C-02655, C-02668, C-03460, C-04040, C-11842, D-00858, D-01790, D-02953, D-02979, D-03514, D-06755, E-00846, E-01260, E-01261, E-01934, E-02410, E-03557, E-04033, E-06775, E-11980, E-26267, F-00530, F-01379, H-02293, H-20982, J-01679, J-11995, J-20054, K-02010, L-00206, L-01654, L-01890, L-02052

D

DATA ANALYSIS A-13511, A-23170, B-01866, B-07075, B-10993, B-14981, B-22868, C-01856, D-01790, D-09984, E-02410, E-07801, E-10219, E-10220, E-11065, J-11114, N-18206

DATA HANDLING SYSTEMS A-00691, A-13511, A-14997, A-23170, A-25418, B-00975, B-01796, B-01866, B-07075, B-10993, B-14981, B-22868, B-25416, C-01856, C-20224, D-01790, D-09984, D-11525, E-01934, E-02410, E-04033, E-06373, E-07801, E-10219, E-10220, E-10421, E-11065, E-16629, E-19737, F-01379, F-22319, J-11114, J-15889, L-01890, L-02052, L-12461, N-18206

DECISIONS L-18220, L-18223

DECOMPOSITION A-12619, A-13494, A-25108, A-26226, B-03337, B-09833, B-19373, B-19471, B-20696, B-22702, B-24678, B-24922, B-25503, B-26084, C-04040, C-26139, F-10429

DELAWARE L-01590

DENSITY A-10424, A-13494, A-24005, B-00567, B-01615, B-03337, B-05868, B-09163, B-09523, B-09600, B-09904, B-15616, B-19602, B-22792, B-22871, B-24269, B-24630, B-24673, C-11193, C-15925, F-04939, F-11163, L-01890, L-26157

DEPOSITION A-16855, A-24005, B-07416, B-12672, B-12797, C-11340, D-25476, E-05702, E-10608, E-21986, E-24569, N-21287

DESIGN CRITERIA A-01842, A-02290, A-04652, A-04778, A-05506, A-05846, A-07800, A-09169, A-10183, A-12120, A-13102, A-13832, A-18052, A-19024, A-23954, A-24508, B-00653, B-00687, B-01615, B-01712, B-01796, B-02195, B-02398, B-02407, B-02424, B-02442, B-02909, B-02974, B-03045, B-03879, B-05162, B-05310, B-07075, B-07229, B-07752, B-08342, B-08352, B-08836, B-09496, B-09546, B-09607, B-09699, B-09788, B-09789, B-09833, B-09905, B-09971, B-10003, B-10681, B-11159, B-11229, B-11238, B-11247, B-11251, B-11253, B-11256, B-11262, B-11281, B-11976, B-12310, B-12424, B-12442, B-12446, B-12581, B-13950, B-13983, B-14269, B-14294, B-14707, B-14730, B-15092, B-15284, B-15489, B-15560, B-15616, B-16250, B-16282, B-16346, B-16496, B-16720, B-16815, B-16863, B-17685, B-17782, B-18034, B-18045, B-19029, B-19541, B-19724, B-19803, B-20063, B-20097, B-20141, B-20188, B-20437, B-20738, B-20914, B-21005, B-21117, B-21200, B-21720, B-22070, B-22071, B-22110, B-22279, B-22500, B-22560, B-22671, B-22702, B-22868, B-22961, B-22986, B-23140, B-23221, B-23231, B-23237, B-23504, B-23674, B-23879, B-23955, B-24168, B-24290, B-24480, B-24516, B-24642, B-24697, B-24777, B-24785, B-24954, B-25019, B-25079, B-25164, B-25795, B-25833, B-25913, B-26143, B-26237, C-00945, C-01354, C-02655, C-02668, C-12126, C-16512, C-22882, C-22885, C-25260, D-16237, E-07843, E-16803, E-19737, F-01852, F-02743, F-11782, F-13620, F-16589, J-07643, J-11846, L-10503, L-11283, L-17321, L-20698, N-17819, N-22794

DESULFURIZATION OF FUELS A-01480, A-02501, A-03587, A-06040, A-06978, A-07642, A-07759, A-08390, A-08391, A-08392, A-09161, A-09831, A-10442, A-11739, A-11790, A-12266, A-13330, A-13511, A-14400, A-14574, A-15391, A-15517, A-16949, A-17418, A-18114, A-18177, A-19038, A-22800, A-23044, A-23359, A-24955, A-25867, B-00135, B-00140, B-00205, B-00276, B-00544, B-00564, B-00567, B-00568, B-01187, B-01362, B-01493, B-02053, B-02149, B-02408, B-02424, B-02813, B-02931, B-02971, B-03337, B-04506, B-04507, B-05198, B-05258, B-05454, B-05529, B-06297, B-06345, B-06636, B-06999, B-07385, B-07416, B-07425, B-07752, B-08347, B-08429, B-08470, B-08584, B-08898, B-08908, B-08917, B-09195, B-09523, B-09666, B-09905, B-09996, B-09999, B-10281, B-10493, B-10655, B-10692, B-10968, B-11215, B-11247, B-11262, B-11910, B-11929, B-12040, B-12091, B-12253, B-12424, B-13051, B-13171, B-13501, B-13570, B-13584, B-13639, B-13663, B-13813, B-13835, B-13856, B-14001, B-14162, B-14838, B-14891, B-15148, B-15240, B-15284, B-15516, B-15692, B-15693, B-15738, B-16279, B-16510, B-17124, B-18110, B-18111, B-18154, B-19339, B-19373, B-19378, B-19395, B-19471, B-19692, B-19804, B-20063, B-20223, B-20563, B-20663, B-20729, B-20794, B-21028, B-21381, B-21819, B-22057, B-22070, B-22127, B-22160, B-22505, B-22740, B-22981, B-23176, B-23315, B-23682, B-23708, B-23718, B-23757, B-23867, B-23880, B-24207, B-24458, B-24609, B-24826, B-24985, B-25284, B-25584, B-26211, B-26230, D-01790, E-00023, F-00530, F-01852, F-02743, F-09967, F-11782, F-13411, F-13573, F-13601, F-14814, F-14851, F-18170, G-01865, G-24021, J-00166, J-01546, J-01659, J-01660, J-02413, J-08059, J-11846, J-23800, J-25961, K-00167, K-21896, L-01590, L-06686, L-06739, L-08686, L-09443, L-09474, L-10998, L-11185, L-11319, L-11526, L-11781, L-13049, L-13055, L-14598, L-17006, L-18223, L-19062, M-08072, N-21360, N-23125

DETERGENT MANUFACTURING B-09788

DETROIT L-00973

DIESEL ENGINES A-08393, A-09353, A-09686, A-10424, A-10754, A-16722, B-04506, B-06636, B-08080, B-10680, B-10770, B-15544, B-19261, C-00886, D-00858, D-09591, D-12496, F-11257, J-00166, L-02011, L-03359, L-05499, M-25143, N-00164, N-21289

DIFFUSION A-01510, A-06040, A-10284, A-15701, A-16073, A-22159, B-01796, B-07466, B-13721, B-15616, B-16815, B-19834, B-22051, B-22884, B-24001, B-24681, C-05216, C-09624, C-11340, C-14733, C-15479, C-16149, C-22511, D-02953, D-04116, D-06777, D-08858, D-09984, D-10723, D-11525, E-00023, E-00846, E-01261, E-01934, E-02410, E-04033, E-04034, E-04035, E-05702, E-06775, E-06823, E-06827, E-07428, E-07843, E-08400, E-10010, E-10219, E-10220, E-10368, E-10421, E-10751, E-11065, E-11370, E-11624, E-11980, E-12353, E-14271, E-15483, E-15511, E-16629, E-16687, E-16803, E-17595, E-17725, E-17734, E-19503, E-19737, E-20163, E-21073, E-21099, E-22313, E-23409, E-24341, E-24391, E-24407, E-24569, E-25212, E-25229, E-26141, E-26267, F-10429, L-01890, L-02960, L-11266, L-12461, L-25688

DIFFUSION MODELS A-10284, A-15701, A-16073, B-15616, B-16815, B-24001, B-24681, C-05216, C-11340, D-04116, D-09984, D-10723, D-11525, E-00846, E-01934, E-04033, E-05702, E-06775, E-07428, E-08400, E-10010, E-10368, E-10421, E-10751, E-11065, E-11370, E-11624, E-11980, E-16629, E-16803, E-17595, E-19737, E-20163, E-21073, E-21099, E-22313, E-24341, E-24391, E-24407, E-25212, E-25229, E-26267, L-01890, L-11266, L-12461, L-25688

DIGESTIVE SYSTEM G-11339

DIGITAL METHODS E-24391

DIOLEFINS A-10424

DISCOLORATION I-07553, I-20820

DISPERSION A-00532, A-00691, A-01350, A-01510, A-01842, A-05506, A-06040, A-10284, A-12335, A-13102, A-14997, A-15517, A-15701, A-16073, A-16788, A-16887, A-17051, A-17199, A-21191, A-22159, A-23170, A-24039, A-24817, B-00687, B-00975, B-01796, B-02311, B-04200, B-07466, B-09666, B-09699, B-10493, B-10770, B-11262, B-11910, B-12581, B-13057, B-13721, B-14159, B-15358, B-15572, B-15616, B-16815, B-18045, B-19029, B-19346, B-19834, B-22051, B-22740, B-22884, B-23237, B-23757, B-23974, B-24001, B-24048, B-24681, B-24985, B-25170, B-25298, B-25677, C-01856, C-03546, C-04040, C-05216, C-09624, C-11340, C-14733, C-15348, C-15479, C-15925, C-16149, C-18012, C-22511, C-23377, C-26139, D-02046, D-02953, D-02979, D-03431, D-04116, D-06777, D-08858, D-09591, D-09984, D-10723, D-11525, D-16237, D-23957, D-25476, E-00023, E-00846, E-01259, E-01260, E-01261, E-01934, E-02410, E-03251, E-03557, E-04033, E-04034, E-04035, E-05357, E-05702, E-06373, E-06775, E-06823, E-06827, E-07428, E-07801, E-07843, E-08400, E-09417, E-10010, E-10053, E-10219, E-10220, E-10368, E-10421, E-10608, E-10751, E-11065, E-11370, E-11514, E-11624, E-11980, E-12353, E-14271, E-15483, E-15511, E-16285, E-16629, E-16687, E-16803, E-16985, E-17580, E-17595, E-17612, E-17725, E-17734, E-19503, E-19737, E-20163, E-20523, E-21073, E-21099, E-21122, E-21736, E-21986, E-22313, E-23163, E-23409, E-24243, E-24341, E-24391, E-24407, E-24486, E-24509, E-24569, E-25212, E-25229, E-25815, E-25935, E-26141, E-26267, F-00530, F-10429, F-11722, G-00981, H-01589, H-07786, J-07643, K-21896, L-01890, L-02960, L-03277, L-08686, L-11266, L-11319, L-11526, L-12461, L-18121, L-25688, N-03344

DISPERSIONS B-03879, B-10680, F-11722

DISSIPATION RATES B-23757, C-26139, E-10010, E-21099

DISSOCIATION B-04791, B-08492, F-16883

DISTILLATE OILS A-07647, A-07759, A-08393, A-09169, A-09737, A-09831, A-12576, A-16888, A-23753, B-08080, B-08713, B-09195, B-10680, B-15148, D-09591, J-00166, J-13613, K-00167, L-08686, L-09443, L-11266, M-00336, M-01220

DIURNAL A-10754, A-15246, D-00657, D-02818, D-03514, D-04116, D-05428, D-06819, D-06824, D-08298, D-08858, D-09591, D-11525, E-07428, E-10229, E-11514, E-20924, E-21122, E-23723, E-25229, L-25688, N-00164

DOMESTIC HEATING A-07642, A-07647, A-07793, A-08392, A-08393, A-09353, A-09737, A-09831, A-10743, A-11413, A-11619, A-12285, A-13855, A-14400, A-14574, A-14701, A-14997, A-16212, A-16722, A-17357, A-17464, A-18052, A-19434, A-19511, A-22418, A-23884, A-24732, A-25259, A-25549, A-26299, B-02974, B-03053, B-04506, B-04516, B-06835, B-08080, B-09833, B-10336, B-18110, B-18296, B-21268, B-25427, B-25584, C-24245, D-00858, D-02057, D-03431, D-04116, D-05428, D-07951, D-08298, D-09591, D-09984, E-08400, E-10153, E-11065, E-11514, E-15347, E-25075, F-00530, G-08230, G-08232, G-11828, G-18109, H-07786, J-01546, J-07643, J-13613, J-21241, J-26193, L-00311, L-01890, L-02011, L-03359, L-07550, L-07950, L-08062, L-09474, L-11266, L-11781, L-20698, L-26157, M-00336, N-04212, N-07845, N-21287, N-21289

DONORA A-16855, F-00530, G-16837, G-18109

DROPLETS A-16788, B-09833, B-25139, E-06827, E-24109, E-24486, I-07553

DRY CLEANING A-00972, D-03431, L-01265, L-06730, N-04212

DRYING F-08943

DUMPS A-09737, A-11981, A-16073, B-01799, B-08938, B-09788, D-00858, L-01890, L-08062, N-00164

DUST FALL A-01350, A-06040, A-10284, A-15246, B-00975, B-01796, C-04040, C-07721, C-24412, D-00657, D-06755, D-07393, D-09591, D-10723, D-22812, E-21986, F-00530, G-21276, J-01308, L-01890, L-02052, L-03277, L-05499, L-07950, L-09445, L-25688

DUSTS A-00532, A-01350, A-02014, A-04937, A-05506, A-07570, A-10442, A-10678, A-11982, A-12541, A-13261, A-13330, A-13410, A-13832, A-15246, A-16410, A-16788, A-19017, A-19084, A-19434, A-21916, A-22875, A-24005, A-24500, A-24817, A-24915, A-25062, A-25213, B-00140, B-00272, B-01485, B-01615, B-01712, B-01796, B-02032, B-02036, B-02149, B-02206, B-02311, B-02398, B-02909, B-03045, B-03232, B-04179, B-04508, B-04634, B-04655, B-04940, B-05163, B-05198, B-05310, B-06062, B-06307, B-06490, B-07075, B-07359, B-07385, B-07416, B-07430, B-07674, B-07931, B-08085, B-08155, B-08346, B-08348, B-08378, B-08470, B-08584, B-08825, B-08836, B-09496, B-09788, B-09789, B-09923, B-10165, B-10681, B-10933, B-11055, B-11906, B-11910, B-12442, B-12581, B-13015, B-13857, B-14194, B-14223, B-14270, B-14294, B-14473, B-14707, B-15155, B-16068, B-16720, B-17318, B-17392, B-17672, B-17905, B-17979, B-18161, B-19029, B-19346, B-19724, B-19803, B-19845, B-19972, B-20097, B-20188, B-20223, B-20243, B-21117, B-21313, B-21886, B-22070, B-22401, B-22501, B-22505, B-22560, B-22671, B-22792, B-23176, B-23220, B-23237, B-23262, B-23305, B-23674, B-23955, B-24480, B-24642, B-24643, B-24697, B-24756, B-25079, B-25127, B-25164, B-25186, B-25207, B-25217, B-25269, B-25323, B-25663, B-25744, B-25973, B-26063, B-26143, C-01857, C-02655, C-04759, C-07721, C-07787, C-07848, C-08123, C-09107, C-09624, C-16512, C-17468, C-17474, C-19519, C-22342, C-22882, C-23121, C-25260, C-25872, D-02979, D-03431, D-06755, D-06819, D-07141, D-07393, D-09591, D-10723, D-22591, D-23326, E-06775, E-07580, F-04939, F-07059, F-11722, G-00981, G-01340, G-02417, G-04136, G-06806, G-07039, G-07138, G-08230, G-11437, G-12289, G-14530, G-20700, G-21276, G-23151, H-02299, H-06967, H-07786, H-20982,

J-01546, J-15889, J-17203, K-02010, K-06778, K-09921, L-00206, L-00311, L-01890, L-02011, L-02052, L-02960, L-03359, L-06737, L-07950, L-08062, L-09474, L-10166, L-17472, L-17473, M-08072, N-04212, N-21287, N-21289
DYE MANUFACTURING C-04040

E

ECONOMIC LOSSES A-04778, B-00135, B-00687, B-00975, D-03432, D-05010, D-05428, H-06967, J-00166, J-00253, J-01659, J-01679, J-08059, J-11995, J-12418, J-16122, J-16174, J-17203, J-19685, J-20054, K-00167, L-01265, L-01585, L-03452, L-06735, L-11185, M-01221
EDUCATION B-08080, L-18220
ELECTRIC CHARGE B-00653, B-04940, B-07931, B-09789, B-22560, C-17474, F-02743, F-09769
ELECTRIC FURNACES A-09686, B-00107, B-25038
ELECTRIC POWER PRODUCTION A-00532, A-00691, A-00943, A-00972, A-01350, A-01480, A-01510, A-01842, A-02014, A-02290, A-02501, A-02633, A-02634, A-02860, A-03072, A-03113, A-03340, A-03867, A-04224, A-04287, A-04652, A-04778, A-04937, A-05011, A-05067, A-05169, A-05506, A-05530, A-06040, A-07642, A-07644, A-07645, A-07647, A-07759, A-07793, A-07800, A-07963, A-08388, A-08391, A-08392, A-08393, A-09075, A-09161, A-09165, A-09169, A-09194, A-09353, A-09482, A-09588, A-09737, A-09831, A-10183, A-10284, A-10424, A-10442, A-10678, A-10743, A-10754, A-11411, A-11413, A-11637, A-11640, A-11655, A-11739, A-11789, A-11860, A-11968, A-11981, A-11982, A-11988, A-12088, A-12120, A-12266, A-12285, A-12335, A-12541, A-12619, A-13053, A-13102, A-13141, A-13292, A-13293, A-13316, A-13479, A-13515, A-13644, A-13785, A-13892, A-13954, A-13963, A-14378, A-14400, A-14478, A-14574, A-14701, A-14794, A-14980, A-14997, A-15246, A-15391, A-15517, A-15701, A-16073, A-16212, A-16239, A-16410, A-16489, A-16492, 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ELECTRIC PROPULSION A-01842, A-02290, A-03867, A-04287, A-07644, A-07793, A-08393, A-10183, A-14980, A-16239, B-02442, B-04506, B-09996, B-21819, B-25529, F-11257, F-14686, L-06686, N-05194, N-17819

ELECTRICAL PROPERTIES A-07644, A-07793, A-09165, A-10183, A-24005, B-00653, B-01485, B-01615, B-02206, B-03337, B-04940, B-05853, B-05868, B-06062, B-07931, B-08348, B-08863, B-09789, B-10704, B-11191, B-11929, B-14473, B-15532, B-15543, B-18111, B-20097, B-20485, B-22560, B-22661, B-22671, B-23305, B-23674, B-23955, B-25127, B-25207, B-25786, B-26143, C-01354, C-01857, C-17474, C-25260, E-10608, E-11370, F-01379, F-02743, F-04939, F-09769, F-11257, F-16589, F-24272, L-06686

ELECTRICAL RESISTANCE B-00653, B-02206, B-06062, B-07931, B-09789, B-14473, B-20097, B-22661, B-23305, B-25127, B-25207, B-25786, F-02743, F-04939, F-09769, F-24272

ELECTROCHEMICAL METHODS A-10183, A-13494, A-21999, B-02442, B-24837, B-25913, C-07482, D-22812

ELECTROCONDUCTIVITY ANALYZERS A-01510, A-15620, A-19084, B-06999, B-16240, B-25637, C-17468, C-22885, C-25260, D-02046, D-08858, E-21099, L-09445, L-17472

ELECTROLYSIS B-02407, B-03337, B-03581, B-08347, B-23054, B-25913, J-16129

ELECTRON MICROSCOPY C-22909, F-15714

ELECTROSTATIC COUNTERS B-00564, B-02407, F-01852

ELECTROSTATIC PRECIPITATORS A-00532, A-00972, A-01350, A-03113, A-04224, A-04778, A-05011, A-05067, A-09686, A-11411, A-11413, A-11640, A-11988, A-17688, A-21204, A-25867, A-26233, B-00107, B-00135, B-00140, B-00564, B-00653, B-01485, B-01615, B-01796, B-02032, B-02036, B-02192, B-02206, B-02909, B-03232, B-04200, B-04508, B-04516, B-04655, B-04940, B-05163, B-05198, B-05508, B-05853, B-05868, B-06062, B-06307, B-06999, B-07385, B-07416, B-07425, B-07515, B-07931, B-08146, B-08155, B-08342, B-08348, B-08470, B-08492, B-08584, B-08863, B-08921, B-09163, B-09496, B-09607, B-09699, B-09789, B-09833, B-09904, B-10003, B-10655, B-10681, B-10692, B-10704, B-11005, B-11159, B-11233, B-11238, B-11251, B-11253, B-11256, B-11262, B-11996, B-12040, B-12091, B-12442, B-12574, B-13015, B-13057, B-13394, B-13569, B-13570, B-13674, B-13856, B-13857, B-14159, B-14207, B-14223, B-14270, B-14294, B-14473, B-14707, B-14730, B-15031, B-15155, B-15532, B-15543, B-16346, B-16720, B-16862, B-17343, B-17672, B-18034, B-18142, B-18290, B-19029, B-19471, B-19541, B-19724, B-20097, B-20485, B-20526, B-20738, B-20854, B-21200, B-21268, B-21381, B-21720, B-21886, B-22070, B-22401, B-22505, B-22552, B-22560, B-22661, B-22671, B-23176, B-23220, B-23305, B-23315, B-23331, B-23674, B-23955, B-24048, B-24181, B-24190, B-24589, B-24630, B-24675, B-24697, B-24756, B-24837, B-24881, B-24985, B-25047, B-25079, B-25127, B-25139, B-25164, B-25170, B-25207, B-25217, B-25269, B-25517, B-25786, B-25833, B-26063, B-26143, C-01354, C-01856, C-01857, C-04040, C-07787, C-08123, C-21663, C-22342, C-22391, C-23096, D-01790, D-05260, D-23356, E-11624, F-02743, F-04939, F-09769, H-02299, H-06967, J-01308, J-01546, J-01707, J-12418, J-15889, J-16122, J-21241, J-26193, K-02010, K-06778, L-01890, L-02052, L-02960, L-03277, L-06615, L-06686, L-08062, L-09474, L-18223, L-20698, L-24033, N-21360

EMISSION INVENTORIES A-00532, A-00972, A-09737, A-10754, A-17398, A-22867, A-25213, B-00975, C-11193, C-14733, D-04116, D-05551, D-07393, D-09591, D-09984, D-11525, D-13176, E-08400, E-11065, L-01265, L-01890, L-03359, L-11266, L-25688

EMISSION STANDARDS A-06040, A-16410, A-19434, A-19994, B-01362, B-02036, B-09666, B-10493, B-16720, B-19471, B-24826, B-25284, B-25298, C-05216, E-10368, E-23163, J-11111, K-02010, K-06696, K-06778, K-09921, K-22248, L-00206, L-00973, L-01890, L-06188, L-06615, L-07794, L-09474, L-14535, L-18121, L-18220, L-20698, L-25688

EMISSIVITY C-04040, C-07941, F-00530

EMPHYSEMA G-11300, G-20700, G-24021, L-03359

EMULSIONS B-10680

ENFORCEMENT PROCEDURES A-19434, A-24500, B-00975, B-14270, J-08059, K-06778, L-01585, L-01590, L-09073, L-18220, L-21431

ENGINE DESIGN MODIFICATION A-17910, A-18052, A-26226, B-04506, B-18110, J-15889

ENGINE EXHAUSTS A-09353, A-09686, A-10424, A-10442, A-12619, A-15620, A-16722, A-16877, B-04506, B-06636, B-08080, B-08584, B-15544, B-19261, D-05428, D-06755, D-08298, E-24439, E-25075, F-00530, G-11828, H-05420, H-07786, J-01546, L-09445, N-00164, N-04212, N-07845, N-21287, N-21289

ENGINE OPERATING CYCLES B-08584, N-00164

ENGINE OPERATION MODIFICATION A-15620, A-16410, B-04506, B-11191, B-22071, B-25677, I-04622

ENGINEERS B-18290, N-01063

ENZYMES F-00530, H-00316

EPIDEMIOLOGY D-02818, F-00530, G-11339, G-12289, G-16837, G-18109, G-20700, G-21276

EQUIPMENT CRITERIA A-05506, A-05530, A-16410, B-02398, B-14269, B-14294, B-22792, F-04939, L-07950

EQUIPMENT STANDARDS B-18296, B-22552, E-10368, L-09474, L-18220

ESTERS B-08352, B-12503

ETHERS B-08352, B-12503, B-25744, B-26211

ETHNIC FACTORS A-24951

ETHYL ALCOHOL B-08352

ETHYLENE B-19373, C-11842, F-22319, H-02299, H-05420

EUROPE A-00532, A-00691, A-00972, A-01350, A-01510, A-02014, A-02549, A-02631, A-02860, A-03113, A-03587, A-04287, A-06351, A-07570, A-07793, A-08388, A-09103 A-09353, A-10424, A-10442, A-10444, A-10678, A-10743, A-11411, A-11413, A-11637, A-11640, A-11655, A-11968, A-11981, A-11982, A-11988 A-12088, A-13102, A-13219, A-13261, A-13330, A-13644, A-13855, A-13978, A-14378, A-14400, A-14478, A-14574, A-14701, A-14794, A-15146, A-15246, A-16239, A-16410, A-16788, A-16855, A-16877, A-17017, A-17280, A-17357, A-17464, A-17910, A-19084, A-19165, A-19434, A-19444, A-21286, A-21318, A-21383, A-22144, A-22418, A-23884, A-24005, A-24915, A-24916, A-25108, A-25259, A-25545, A-25549, B-00135, B-00140, B-00205, B-00222, B-00276, B-00544, B-00564, B-00653, B-00687, B-00975, B-01245, B-01485, B-01493, B-01712, B-01727, B-01796, B-01799, B-01866, B-02032, B-02053, B-02149, B-02311, B-02398, B-02407, B-02424, B-02442, B-02778, B-02970, B-02971, B-02974, B-03045, B-03053, B-03337, B-03581, B-03879, B-03974, B-04179, B-04634, B-04791, B-06062, B-06307, B-06345, B-06835, B-06999, B-07229, B-07359, B-07673, B-07931, B-08146, B-08155, B-08371, B-08470, B-08492, B-08574, B-08584, B-08825, B-09600, B-09607, B-10165, B-10264, B-10336, B-10399, B-10591, B-10933, B-11005, B-11055, B-11247, B-11854, B-11906, B-11910, B-11976, B-11985, B-11996, B-13052, B-13057, B-13243, B-13636, B-13767, B-13817, B-13829, B-13950, B-13983, B-14057, B-14270, B-14294, B-14473, B-14546, B-14660, B-14707, B-15155, B-15244, B-15357, B-15358, B-15378, B-15489, B-15616, B-15665, B-15913, B-15946, B-15976, B-16224, B-16240, B-16250, B-16496, B-16510, B-16720, B-16863, B-16872, B-17004, B-17318, B-17672, B-17685, B-17979, B-18161, B-18296, B-19029, B-19048, B-19339, B-19346, B-19380, B-19394, B-19395, B-19475, B-19480, B-19482, B-19541, B-19608, B-19619, B-19629, B-19670, B-19678, B-19692, B-19724, B-19803, B-19804, B-19874, B-19876, B-20073, B-20141, B-20188, B-20223, B-20243, B-20425, B-20550, B-20563, B-20738, B-20995, B-21028, B-21117, B-21136, B-21200, B-21313, B-21504, B-21886, B-21893, B-22014, B-22051, B-22070, B-22103, B-22110, B-22279, B-22401, B-22500, B-22501, B-22505, B-22560, B-22671, B-22702, B-22740, B-22883, B-22884, B-22905, B-22961, B-22986, B-23237, B-23305, B-23315, B-23504, B-23544, B-23674, B-23718, B-23757, B-23773, B-23879, B-23955, B-23974, B-24019, B-24270, B-24397, B-24441, B-24554, B-24565, B-24609, B-24613, B-24642, B-24697, B-24707, B-24756, B-24785, B-25127, B-25139, B-25164, B-25170, B-25186, B-25217, B-25269, B-25320, B-25323, B-25427, B-25430, B-25494, B-25584, B-25637, B-25663, B-25677, B-25743, B-25744, B-25786, B-25787, B-25795, B-25833, B-25973, B-26063, B-26084, B-26143, B-26155, B-26237, C-00403, C-00886, C-00945, C-01354, C-01363, C-01856, C-01857, C-02655, C-02668, C-02921, C-03460, C-03546, C-03592, C-04040, C-04759, C-05216, C-07848, C-08123, C-11842, C-14733, C-15348, C-17474, C-19047, C-19519, C-22342, C-22511, C-22885, C-22982, C-25147, C-25872, D-00858, D-01790, D-02046, D-02057, D-02818, D-02953, D-02979, D-03514, D-05260, D-06755, D-06777, D-06819, D-07141, D-07393, D-08298, D-08858, D-10723, D-13176, D-16237, D-22591, D-23326, D-23356, E-00023, E-00846, E-01259, E-01260, E-01261, E-01934, E-02410, E-03251, E-03557, E-04033, E-06775, E-06827, E-07580, E-08400, E-10153, E-10219, E-10220, E-10229, E-10368, E-10751, E-11370, E-11514, E-11980, E-13965, E-15347, E-16467, E-16629, E-16687, E-16803, E-16985, E-17612, E-20042, E-20163, E-20924, E-21122, E-21736, E-21986, E-22313, E-23163, E-24341, E-25075, E-25212, E-26267, F-00105, F-00530, F-01379, F-01380, F-01852, F-02743, F-09064, F-11135, F-11722, F-13766, F-14390, F-18170, F-22319, F-22587, G-00981, G-01340, G-01865, G-02417, G-06806, G-06826, G-07138, G-08230, G-08232, G-11437, G-12289, G-14530, G-16192, G-16837, G-18109, H-02293, H-02299, H-06967, H-07786, H-19620, H-20982, J-00166, J-01679, J-01707, J-02151, J-07643, J-11995, J-17203, J-20054, K-00167, K-02010, K-06778, K-09921, K-22248, L-00162, L-00206, L-00311, L-01654, L-01890, L-02011, L-02052, L-02831, L-03452, L-07950, L-09474, L-10166, L-11242, L-11266, L-11383, L-12031, L-14535, L-17006, L-17472, L-17473, L-20698, L-21431, L-24033, M-01567, N-04212, N-07845, N-21287, N-21289, N-22794

EXCESS AIR A-04778, A-05011, A-05067, A-09103, A-12619, A-24817, A-26226, B-02398, B-03974, B-05258, B-07962, B-08346, B-08870, B-09163, B-09833, B-10993, B-18167, B-18290, B-19471, B-20082, B-23880, B-24678, F-09064

EXHAUST SYSTEMS A-13832, B-02032, B-04179, B-08085, B-0[illegible]378, B-19724, B-21313, B-21720, B-22702, B-23262, B-24697, C-01354, C-21663

EXPERIMENTAL EQUIPMENT A-02290, A-13494, B-00205, B-01615, B-03879, B-04634, B-04655, B-04755, B-04842, B-06307, B-08825, B-09971, B-10165, B-15532, B-15543, B-15560, B-22560, C-07787, C-09107, C-22882, E-06373, E-11624, F-01852, F-09769

EXPERIMENTAL METHODS A-05011, A-08641, A-13494, A-13511, A-16877, B-02032, B-03879, B-09469, B-09971, B-10165, B-11215, B-11233, B-14223, B-21028, B-23718, B-25186, C-07787, C-09107, C-18012, C-26139, D-06777, E-04033, F-04939, F-09769, F-09967, F-10429, F-13411, F-13572, F-14851, G-06806, G-06826, G-18109, H-02293

EXPLOSIONS A-17483

EXPOSURE CHAMBERS A-10424

EYE IRRITATION D-03514, G-07138, G-12289, I-20820, L-11266

EYES G-07138, G-08232, I-20820

F

FALLOUT E-10608

FANNING C-11340, C-15925, E-15483, E-21122

FANS (BLOWERS) A-13832, B-02032, B-04179, B-08085, B-19724, B-21313, B-21720, B-23262, B-24697, C-01354

FARMS F-00530

FEASIBILITY STUDIES A-03072, A-13644, A-14980, A-21221, B-01187, B-02813, B-03879, B-06543, B-06697, B-10681, B-11281, B-13663, B-14730, B-15665, B-17905, B-20794, B-23221, B-23504, C-15515, E-15483, F-01379, F-11782, F-16210, J-01659, J-01660, J-02413, J-11111, J-11114, J-11846, L-06686, L-10998, L-11283, L-14598, L-19062

FEDERAL GOVERNMENTS A-09353, A-22800, A-24535, A-26299, B-08917, B-09996, B-10493, B-22559, B-23176, B-23880, C-24245, E-06373, G-08232, H-11733, J-16506, K-00167, L-00206, L-01654, L-05105, L-05499, L-06615, L-08062, L-09073, L-09443, L-09474, L-11266, L-11319, L-18121, L-18220, L-18223, L-19062, N-21287

FEES L-21431

FEMALES G-11339, G-18109

FERTILIZER MANUFACTURING A-17357, A-21221, B-14159, B-22441, B-24142, B-25038, J-21241

FERTILIZING A-08392, B-08836, B-08938, B-09788, B-09996, B-10281, B-10591, B-24142, B-25038, H-02293, L-11242

FIELD TESTS B-00975, B-05857, B-07075, B-09546, B-09833, B-10264, B-12308, B-23140, C-01363, C-03460, C-04040, C-16364, C-22882, D-06777, D-09984, E-04033, E-10010, E-20523, F-13411

FILTER FABRICS A-09686, A-13410, B-00107, B-00140, B-04508, B-04755, B-05163, B-07075, B-07385, B-07416, B-07515, B-08155, B-08870, B-09788, B-09833, B-10003, B-12310, B-14207, B-14270, B-20188, B-22057, B-22505, B-23955, B-24290, D-02818, D-07951, D-22812, F-09769, F-11163, I-07553

FILTERS A-00972, A-03587, A-04778, A-04937, A-08392, A-09686, A-13410, A-19994, A-26233, B-00107, B-00140, B-00205, B-01187, B-01712, B-02053, B-04508, B-04516, B-04655, B-04755, B-05163, B-05310, B-07075, B-07229, B-07385, B-07416, B-07515, B-08155, B-08870, B-09788, B-09833, B-10003, B-11910, B-12310, B-13394, B-13569, B-14207, B-14223, B-14269, B-14270, B-14707, B-16720, B-16872, B-18154, B-18161, B-19261, B-19724, B-19834, B-20188, B-20437, B-20738, B-20854, B-21324, B-22057, B-22401, B-22505, B-22615, B-22871, B-23262, B-23315, B-23955, B-24048, B-24290, B-24642, B-24697, B-24756, B-24837, B-24881, B-24985, B-25323, B-26063, C-01363, C-08123, C-21663, C-22882, D-01790, D-02818, D-05260, D-06755, D-07951, D-22812, F-09769, F-11163, H-06967, I-07553, J-01308, J-01546, J-17203, J-21241, J-26193, K-09921, L-08062

FIRING METHODS A-00532, A-02633, A-02634, A-03072, A-04778, A-04937, A-05011, A-05067, A-09103, A-10442, A-10743, A-11968, A-12619, A-16410, A-19038, A-23359, A-23884, A-24817, A-26226, B-02398, B-03053, B-03974, B-04516, B-04634, B-05162, B-05163, B-05258, B-05857, B-07962, B-08085, B-08346, B-08870, B-08908, B-09163, B-09833, B-10399, B-10993, B-11191, B-12308, B-12443, B-12446, B-13394, B-13813, B-15560, B-16068, B-16502, B-17250, B-17392, B-17782, B-18167, B-18290, B-18296, B-19034, B-19471, B-20082, B-21234, B-[illegible]1381, B-21643, B-23880, B-24073, B-24480, B-24642, B-24678, B-25517, D-11525, E-11065, F-01852, F-04939, F-09064, F-16376, L-20698

FLAME AFTERBURNERS B-20243

FLAME IONIZATION DETECTOR A-05067, A-22144

FLORIDA C-16875, C-18012, L-00973, L-11266, L-18223

FLOW RATES A-09103, A-09165, A-24005, A-25196, B-05162, B-05310, B-05508, B-05531, B-05868, B-07075, B-07430, B-07674, B-08347, B-08348, B-08352, B-08863, B-08870, B-08939, B-09163, B-09788, B-09789, B-09833, B-19560, B-19834, B-22110, B-22401, B-22756, B-22792, B-23221, B-23262, B-23305, B-24270, B-24554, B-24642, B-25416, B-26143, C-01354, C-07787, C-09107, C-22882, C-23121, C-25260, E-06775, E-24569, F-09967, F-14851

FLOWERS H-02299, H-05420, H-06967

FLOWMETERS B-07075, B-08352, C-01354

FLUID FLOW A-09103, A-09165, A-24005, A-25196, B-05162, B-05310, B-05508, B-05531, B-05853, B-05868, B-07075, B-07430, B-07674, B-08347, B-08348, B-08352, B-08863, B-08870, B-08939, B-09163, B-09788, B-09789, B-09833, B-10704, B-19560, B-19629, B-19834, B-22110, B-22401, B-22756, B-22792, B-22961, B-23221, B-23262, B-23305, B-24270, B-24554, B-24642, B-25416, B-26143, C-01354, C-07787, C-09107, C-11340, C-22882, C-23121, C-25260, E-06775, E-09417, E-24569, F-09967, F-11722, F-11782, F-14851

FLUORANTHENES A-05067, A-10424, A-16877, C-00945

FLUORESCENCE A-07570, C-04040, C-26139

FLUORIDES A-17464, B-11238, B-25038, C-23096, D-03514, D-22812, H-00316, H-01398, H-02299, H-05420, H-07786, I-07553, K-02010, L-00973, N-04212

FLUORINE A-06351, A-19434, A-22875, B-25427, D-22812, H-06967, L-24033

FLUORINE COMPOUNDS A-17357, A-17464, A-24039, B-11238, B-25038,

B-25427, C-23096, D-03514, D-22812, H-00316, H-01398, H-02299, H-05420, H-06967, H-07786, I-07553, K-02010, L-00973, I-03452, L-17472, N-04212, N-21287
FLY ASH A-00532, A-00972, A-02860, A-03113, A-04937, A-05067, A-05169, A-09161, A-09194, A-09686, A-09831, A-10442, A-11411, A-11413, A-11502, A-11860, A-11981, A-11982, A-11988, A-12266, A-13832, A-14478, A-16855, A-16949, A-19318, A-21286, A-21351, A-22418, A-22875, A-23359, A-24535, A-24732, A-25689, A-25867, B-00107, B-00135, B-00140, B-00653, B-01187, B-01245, B-01362, B-01615, B-02192, B-02206, B-02908, B-02909, B-02974, B-03879, B-04200, B-04940, B-05163, B-05310, B-05508, B-05531, B-05853, B-05868, B-06490, B-06697, B-06835, B-07359, B-07430, B-07515, B-07752, B-08085, B-08146, B-08155, B-08348, B-08492, B-08825, B-08863, B-08870, B-08919, B-08921, B-08922, B-08923, B-08925, B-08926, B-08936, B-08937, B-08938, B-08939, B-08940, B-08942, B-09191, B-09496, B-09600, B-09607, B-09789, B-09833, B-09904, B-10264, B-10655, B-10681, B-10704, B-11005, B-11159, B-11253, B-11262, B-11996, B-12310, B-12417, B-12574, B-12797, B-14087, B-14137, B-14159, B-14269, B-14730, B-15031, B-15251, B-15543, B-15665, B-15902, B-16173, B-16224, B-16248, B-16502, B-16746, B-16862, B-18034, B-18063, B-18142, B-19471, B-19480, B-19541, B-19834, B-19845, B-20082, B-20485, B-20552, B-20854, B-21268, B-21313, B-21643, B-21720, B-22175, B-22661, B-22756, B-22869, B-22871, B-22961, B-23140, B-23220, B-23331, B-23822, B-24181, B-24480, B-24630, B-24675, B-24837, B-25038, B-25079, B-25170, B-25207, B-25517, B-25786, C-00403, C-00886, C-03460, C-04040, C-04889, C-07941, C-13477, C-16734, C-16860, C-22909, C-25260, C-26139, D-01790, D-02979, D-05260, D-07141, E-00023, E-07843, E-10219, E-11370, E-11624, E-16687, E-16803, E-25815, F-00530, F-04939, F-08941, F-08943, F-09769, F-15714, G-02417, G-07138, H-07786, J-01308, J-01546, J-01707, J-02151, J-06845, J-12418, K-06696, K-22248, L-00206, L-00311, L-00973, L-01654, L-02831, L-02960, L-03277, L-07550, L-07794, L-09443, L-09474, L-19062, L-20698, M-08072, N-02632, N-04432, N-07431, N-21289, N-21360
FOG A-01510, A-22159, B-17531, D-08858, E-06827, E-24109, E-24439, E-24486, G-00981, G-08230, G-08232, G-16837, G-18109, H-02299, N-04212
FOOD AND FEED OPERATIONS A-00972, A-09686, A-25213, B-09788, B-21117, B-25019, D-00858, D-12496, G-11828, H-06967, J-26193, L-01890, L-06730, L-08062
FOODS A-25914
FORESTS C-16875, C-18012, E-10153, F-00530, H-01014, H-07786
FORMALDEHYDES A-00532, A-03113, A-05011, A-05067, A-16722, B-06636, C-03592, D-22812
FRACTIONATION B-25184
FRANCE A-08388, A-13855, A-17357, A-19165, A-22144, B-00222, B-00276, B-01866, B-02149, B-02424, B-03337, B-03974, B-06345, B-06835, B-07359, B-13057, B-15358, B-15378, B-15616, B-17672, B-19480, B-20073, B-22401, B-22560, B-22671, B-22702, B-24785, B-25677, C-25147, D-06819, F-01852, F-02743, J-00166, K-00167, L-09474, L-17006
FREEZING B-09607, B-24001, E-24439, F-11163
FROTH FLOATATION A-10442, A-18114, B-00564, B-02931, B-05454, B-06297, B-09523, B-09666, B-09996, B-10968, B-12091, B-12253, B-13584, B-13856, F-13573
FRUITS H-00316, H-02299, H-05420, H-06967
FUEL ADDITIVES A-10442, B-03974, B-06999, B-07962, B-08080, B-08713, B-09163, B-09191, B-10680, B-10770, B-12253, B-13856, B-14394, B-14838, B-17672, B-18167, B-19642, B-20082, B-20563, B-23331, B-24190, B-25164, C-16860
FUEL CELLS A-02290, A-04287, A-07644, A-07793, A-08393, A-10183, A-14980, B-02442, B-04506, B-09996, B-25529, F-11257, F-14686, L-06686
FUEL CHARGING A-02634, A-10743, B-04634, B-05162, B-05163, B-08085, B-10399, B-12308, B-12443, B-24480, D-11525, F-04939
FUEL CRITERIA A-13494, A-14980, A-16410, A-17051, B-13394, B-13501, B-13578, B-13584, B-13592, F-13572, F-13573, F-13601, G-24021, N-13587, N-13591
FUEL EVAPORATION L-00311, L-01890
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GASES A-03113, A-03587, A-07570, A-10424, A-10442, A-19994, A-24817, A-25062, A-25867, B-00653, B-00975, B-01485, B-01493, B-02407, B-02424, B-02970, B-02974, B-03045, B-03337, B-04179, B-04634, B-04791, B-05338, B-07075, B-07673, B-07931, B-08352, B-08825, B-09833, B-10003, B-10933, B-11238, B-15902, B-19876, B-25139, C-09624, E-11370, E-13965, E-24569, F-10422, F-10429, F-11163, F-13766, F-14851, F-16376, F-22319, G-02417, H-02299, I-04622, I-07553, K-00167
GASIFICATION (SYNTHESIS) A-08390, A-08391, A-08392, A-12266, A-15391, A-24955, A-25867, B-00564, B-02408, B-02424, B-05454, B-08908, B-09666, B-09905, B-10281, B-11262, B-11910, B-12424, B-13813, B-15240, B-16279, B-16510, B-17124, B-20663, B-20794, B-23176, B-23880, F-14851, J-11846, L-06686, L-11526, L-13049, L-14598, N-23125
GASOLINES A-00943, A-00972, A-09353, A-09737, A-10754, A-15620, A-18052, A-25213, B-04516, B-08713, B-09195, B-10680, B-19261, B-19670, D-04116, D-05010, D-05260, D-05551, D-08298, D-09591, E-24109, F-00530, F-11257, L-00206, L-01890, L-07550, L-08686, N-00164, N-13591
GEORGIA A-01489, C-07516, L-11185, L-11781
GERMANY A-03587, A-10678, A-11411, A-11413, A-11637, A-11640, A-11655, A-11968, A-12088, A-13644, A-14378, A-14478, A-14574, A-15246, A-16410, A-17464, A-19084, A-19434, A-19444, A-21286, A-21318, A-23884, A-25259, A-25549, B-01712, B-01727, B-02032, B-02053, B-02971, B-02974, B-04791, B-06062, B-06345, B-06999, B-07229, B-08371, B-08584, B-08825, B-10933, B-11005, B-11055, B-11854, B-11906, B-13829, B-14294, B-14473, B-14546, B-14660, B-15155, B-15357, B-16240, B-16720, B-16863, B-16872, B-19048, B-19339, B-19346, B-19380, B-19692, B-19803, B-19804, B-20223, B-20243, B-20550, B-21028, B-21117, B-21200, B-21313, B-21504, B-21886, B-21893, B-22500, B-22501, B-22505, B-22740, B-22905, B-23504, B-23544, B-23674, B-23718, B-23757, B-23974, B-24019, B-24270, B-24397, B-24441, B-24554, B-24609, B-24642, B-24707, B-24756, B-25139, B-25186, B-25269, B-25430, B-25637, B-26063, B-26084, B-26155, B-26237, C-15348, C-17474, C-19047, C-19519, C-22342, C-25872, D-06755, D-23356, E-06775, E-15347, E-21122, E-22313, E-25212, F-00530, F-22319, F-22587, G-06806, G-14530, H-06967, J-01707, J-02151, J-17203, K-00167, L-00162, L-00311, L-11266, L-11383, L-14535, L-17006, L-17472, L-17473, L-21431, M-01567, N-21287, N-21289, N-22794
GLADIOLI H-05420
GLANDS G-07138
GLASS FABRICS A-09686, A-13410, B-00107, B-00140, B-04508, B-04755, B-05163, B-07075, B-07515, B-08870, B-09788, B-12310, B-14207, B-22057, B-22505, D-02818, D-07951, D-22812, F-09769, F-11163, I-07553
GOBPILE BURNING A-10740
GOVERNMENTS A-09353, A-16073, A-19434, A-22800, A-24535, A-26299, B-00107, B-00975, B-06345, B-08080, B-08348, B-08917, B-09996, B-10493, B-22559, B-23176, B-23708, B-23880, C-24245, D-03432, E-06373, G-08232, H-11733, J-00253, J-08059, J-16506, K-00167, K-06696, K-06778, L-00162, L-00206, L-01654, L-03359, L-05105, L-05499, L-06615, L-07550, L-07950, L-08062, L-09073, L-09443, L-09445, L-09474, L-11185, L-11266, L-11319, L-12031, L-17006, L-18121, L-18220, L-18223, L-19062, L-24033, L-25688, M-01221, M-01567, N-21287, N-21360
GRAIN PROCESSING D-00858, L-01890
GRANTS L-01590, L-08062
GRAPES H-05420
GRAPHITE B-09788, G-11300
GRASSES B-08938, H-02299
GRAVITY SETTLING A-09686, B-05163, B-07385, B-19834, B-24609, B-25584, E-24569
GREAT BRITAIN A-01350, A-01510, A-03587, A-09353, A-10424, A-10444, A-10743, A-11655, A-13102, A-14400, A-14794, A-16239, A-16788, A-16855, A-16877, A-21383, A-24005, A-24916, A-25108, B-01727, B-02311, B-02778, B-02971, B-06345, B-06999, B-07673, B-08574, B-09600, B-11247, B-13052, B-13636, B-13767, B-13950, B-14270, B-15489, B-16250, B-16720, B-17685, B-17979, B-18161, B-19029, B-19394, B-19395, B-19475, B-19480, B-19608, B-19670, B-19678, B-19874, B-19876, B-20141, B-20188, B-20425, B-20995, B-21136, B-22014, B-22051, B-22070, B-22103, B-22110, B-22279, B-23237, B-23305, B-23315, B-23879, B-23955, B-24697, B-25127, B-25164, B-25170, B-25323, B-25663, B-25786, B-25833, B-25973, B-26143, C-01857, C-04759, C-07848, C-22885, D-02046, D-02057, D-06777, D-08858, D-16237, E-01259, E-01260, E-01261, E-03251, E-03557, E-06775, E-06827, E-08400, E-10751, E-11514, E-16803, E-16985, E-21736, E-21986, E-24341, E-25075, F-09064, F-11135, F-13766, F-18170, G-00981, G-02417, G-06826, G-08230, G-08232, G-16837, G-18109, J-01707, K-02010, K-06778, K-09921, L-00311, L-02052, L-07950, L-12031, L-14535, L-20698, L-24033, N-04212, N-07845
GREENHOUSES B-08938
GROUND LEVEL A-01510, A-12335, B-00687, B-01796, B-22051, B-22500, B-24001, B-24985, B-25298, C-01856, C-02668, C-22885, C-23377, D-02953, D-02979, D-06777, D-08858, D-16237, E-00846, E-01260, E-01261, E-01934, E-03251, E-03557, E-05702, E-06373, E-06823, E-07843, E-10010, E-10220, E-10229, E-10368, E-10608, E-10751, E-13965, E-16467, E-16629, E-16687, E-16985, E-17595, E-17725, E-20924, E-21736, E-21986, E-22313, E-24109, E-24407, E-24486, E-24569, E-26141, E-26267, L-01890, L-02052, N-03344, N-07845
GUINEA PIGS G-08232, G-11300, I-20820

H

HALOGEN GASES A-06351, A-09686, A-19434, A-19994, A-21383, A-22875, B-03045, B-06543, B-06636, B-09833, B-15693, B-25427, B-26220, D-22812, E-24109, G-07138, H-05420, H-06967, K-02010, K-06778, L-00311, L-24033
HAMSTERS G-11300
HARBORS L-24214
HAZE A-10678, B-10680, F-01379
HEALTH IMPAIRMENT A-02860, A-22875, B-00140, B-00975, B-06999, C-01857, D-03514, E-25075, F-00530, G-00981, G-01340, G-01865, G-02417, G-06826, G-07138, G-11300, G-23670, H-01589, J-00166, L-00206, L-02960
HEALTH STATISTICS F-00530, G-04136
HEARINGS A-24732, B-08917, G-24021, L-06730, L-06735, L-06737, L-06739, L-11319, N-03344
HEAT CAPACITY B-03337, F-00530
HEAT OF COMBUSTION A-08390, B-19678, E-11370, F-09064

HEAT TRANSFER A-07644, A-08391, A-09103, A-13141, B-01493, B-03879, B-07425, B-07466, B-07673, B-07931, B-08836, B-08923, B-09469, B-09607, B-09833, B-11178, B-12581, B-13052, B-13950, B-15378, B-19541, B-19560, B-19670, B-20779, B-20995, B-21200, B-22001, B-23027, B-23146, B-24001, B-24777, B-24785, B-25038, B-25088, B-25323, B-25602, E-03557, E-16985, E-24109, E-24439, F-01379, F-01380, F-09064, F-10429, F-11163, F-14390, L-06686, N-13513

HEIGHT FINDING A-00691, B-00687, B-09699, B-10493, B-11229, B-15616, B-22500, B-22884, B-23974, B-25298, C-01856, C-11340, C-22511, D-09984, E-01260, E-01261, E-03557, E-06775, E-07843, E-11370, E-15511, E-24243, E-25815, K-02010, K-21896, L-00206, L-01654

HEMATOLOGY A-11988, F-00530, G-07138, G-21276

HEMEON AUTOMATIC SMOKE SAMPLERS B-00975, C-11193, D-06755, L-03277, L-09445

HERBICIDES H-05420

HI-VOL SAMPLERS B-01796, B-04200, C-01354, C-01856, C-24412, D-02818, D-06755, D-07951, D-08298, D-09591, D-22812, G-21276, L-01890, L-03277, L-09445, N-04212

HIGHWAYS A-10754, B-08925, B-09600

HOURLY A-01510, D-02046, D-05428, D-08858, D-16237, E-01934, E-11065, E-25229, E-26267, N-00164

HOUSE HEARINGS B-08917, L-11319

HOUSTON C-16875, L-08062

HUMANS A-10754, A-16855, A-19994, A-21999, A-22875, A-25914, B-06999, D-02818, D-06755, D-22591, E-25075, F-00530, G-01865, G-04136, G-06826, G-07138, G-08230, G-08232, G-11339, G-11437, G-11828, G-12289, G-16192, G-16837, G-18109, G-21276, G-23151, G-23670, G-24021, I-20820, J-00166, L-00311, L-03359, L-03452, L-18223, N-04212

HUMIDITY A-16788, B-01485, B-05531, B-16863, B-20779, B-23331, B-24001, B-25186, B-26220, C-23350, E-08400, E-10229, E-20924, E-23409, E-23723, E-25212, F-01379, G-06826, I-07553, L-03277, L-12461

HYDROCARBONS A-00532, A-00972, A-02549, A-03113, A-05011, A-05067, A-07570, A-08390, A-08391, A-08393, A-09686, A-09737, A-09831, A-10424, A-10442, A-10754, A-13494, A-14997, A-16877, A-17017, A-17464, A-19434, A-22144, A-22418, A-23726, A-23884, A-25213, A-25545, A-25549, B-00107, B-00975, B-01362, B-02442, B-02813, B-03337, B-04179, B-04200, B-04506, B-05857, B-06543, B-06636, B-08080, B-08352, B-09195, B-09666, B-09833, B-10493, B-11910, B-12040, B-12503, B-13636, B-18110, B-19261, B-19373, B-19378, B-19471, B-21232, B-21819, B-22012, B-24516, B-25184, B-25427, B-25503, C-00945, C-03592, C-11842, C-21663, D-00858, D-07393, D-12496, D-22812, F-10422, F-10429, F-13766, F-22319, F-22587, G-11828, G-21276, H-00316, H-02299, H-05420, H-07786, J-01546, J-15889, J-16174, J-21241, K-00167, L-00206, L-00973, L-01654, L-01890, L-06188, L-07550, L-17472, M-00336, M-25188, N-00164, N-04212, N-07845, N-21287, N-21289

HYDROCHLORIC ACID A-17464, K-06778, L-00311, L-17472, L-24033, N-04212

HYDROCYANIC ACID A-22875, B-26211

HYDRODESULFURIZATION B-00205, B-02149, B-06345, B-08347, B-08917, B-09999, B-11929, B-20794, B-22057, B-23718, G-01865, J-00166, K-00167, L-01590, L-06739

HYDROFLUORIC ACID D-22812, H-05420, K-06778, L-24033, N-04212

HYDROGEN A-08390, A-08391, A-09103, A-12266, A-13494, A-16887, A-19994, A-22875, B-02407, B-03581, B-04634, B-06543, B-09833, B-10281, B-11929, B-15692, B-15693, B-18111, B-19373, B-19670, B-23054, B-23374, C-13477, C-25147, F-01852, F-10422, F-10429, F-22587, L-14598, N-07845

HYDROGEN SULFIDE A-09831, A-12266, A-13978, A-17017, A-25213, B-00975, B-02424, B-02772, B-03045, B-03337, B-03581, B-08347, B-08908, B-08917, B-09666, B-09905, B-10281, B-11131, B-11910, B-13829, B-15284, B-15357, B-19378, B-19475, B-19560, B-20550, B-21005, B-21893, B-22012, B-22103, B-22809, B-23376, B-23526, B-24458, B-24516, B-24565, B-25320 [illegible], B-26211, C-23350, D-03514, D-05[illegible], D-06824, D-07393, D-08298, D-09591, D-10723, D-22812, D-23356, F-11782, F-14851, G-07138, H-06967, I-07553, I-20820, K-02010, K-06778, L-00311, L-03277, L-03452, L-06686, L-17472, L-24033, N-04212

HYDROGENATION A-08390, A-08391, A-22875, B-00564, B-09195, B-23176, F-11782, K-00167

HYDROLYSIS A-13494, B-08492

HYDROXIDES B-03337, B-03581, B-08825, B-09833, B-10591, B-14394, B-14838, B-15692, B-23880, B-26084, F-08943

HYGROSCOPICITY A-19017, B-08825, B-09163, B-09833

I

ICE B-17531, E-24109, E-24439

IDAHO C-07516, K-00167, M-01220, M-01221

ILLINOIS A-01489, A-09539, A-09989, A-12202, A-16887, B-01866, B-06297, B-06636, B-09195, B-13663, C-07516, D-00858, D-09984, D-11525, E-11065, E-19737, E-25229, F-01380, F-04827, K-00167, L-00973, L-01890, L-03452, L-05105, L-06188, L-09443, L-11266, L-12461, L-17321, L-18121, L-26157, N-21360

IMMUNOLOGY G-08230

IMPINGERS A-05067, A-19994, B-00975, C-16860, C-23121, D-06755, D-22812, E-11624

INCINERATION A-00943, A-00972, A-07963, A-09686, A-09737, A-10424, A-10442, A-10678, A-10754, A-11411, A-11413, A-11637, A-11640, A-11655, A-11968, A-25213, A-25549, A-26299, B-00107, B-00975, B-02398, B-09789, B-10968, B-15544, B-15933, B-19261, B-23262, B-24954, B-26063, C-03460, C-06095, C-17468, C-21663, C-24412, D-00858, D-05010, D-09591, D-22812, F-13620, G-01865, H-07786, J-11114, K-09921, L-00206, L-00973, L-01265, L-01399, L-01890, L-03359, L-06730, L-07550, L-08062, L-09445, L-11526, L-25688, M-00336, N-00164

INDIANA A-01489, A-09737, B-01796, B-06297, C-07516, C-18012, L-00973, L-11185, L-11781

INDUSTRIAL AREAS A-07570, A-07647, A-16073, A-17199, A-24500, B-02149, B-11910, B-23757, C-15348, D-02057, D-03432, D-03514, D-07141, D-07393, D-07951, D-09591, D-13176, D-23326, E-06775, E-07580, G-07138, G-23151, H-19620, J-21241, L-00162, L-01399, L-07550, L-07950, L-08062, L-09474, L-24214, M-00336, N-21289

INDUSTRIAL EMISSION SOURCES A-00532, A-00691, A-00943, A-00972, A-01350, A-01480, A-01510, A-01842, A-02014, A-02290, A-02501, A-02549, A-02633, A-02634, A-02765, A-02860, A-03072, A-03113, A-03340, A-03587, A-03867, A-04224, A-04287, A-04652, A-04778, A-04937, A-05011, A-05067, A-05169, A-05506, A-05530, A-06040, A-07570, A-07642, A-07644, A-07645, A-07647, A-07759, A-07793, A-07800, A-07963, A-08388, A-08391, A-08392, A-08393, A-09075, A-09161, A-09165, A-09169, A-09194, A-09353, A-09482, A-09588, A-09686, A-09737, A-09831, A-10183, A-10284, A-10424, A-10442, A-10678, A-10740, A-10743, A-10754, A-11411, A-11413, A-11619, A-11637, A-11640, A-11655, A-11739, A-11789, A-11860, A-11968, A-11981, A-11982, A-11988, A-12088, A-12120, A-12266, A-12285, A-12335, A-12541, A-12619, A-12633, A-13053, A-13102, A-13141, A-13261, A-13292, A-13293, A-13316, A-13410, A-13479, A-13515, A-13644, A-13785, A-13892, A-13954, A-13963, A-14378, A-14400, A-14478, A-14574, A-14701, A-14794, A-14980, A-14997, A-15246, A-15391, A-15517, A-15701, A-16073, A-16212, A-16239, A-16410, A-16489, A-16492, A-16722, A-16788, A-16855, A-16887, A-16949, A-17051, A-17052, A-17184, A-17199, A-17280, A-17357, A-17398, A-17464, A-17483, A-17542, A-17688, A-17910, A-18052, A-18056, A-18078, A-18176, A-18177, A-18276, A-19024, A-19084, A-19165, A-19318, A-19434, A-19511, A-19994, A-20736, A-20863, A-21191, A-21204, A-21221, A-21286, A-21318, A-21351, A-21916, A-21999, A-22144, A-22159, A-22418, A-22649, A-22800, A-22867, A-22875, A-23044, A-23170, A-23359, A-23379, A-23619, A-23652, A-23726, A-23753, A-23954, A-24039, A-24500, A-24508, A-24535, A-24732, A-24817, A-24915, A-24916, A-24951, A-24955, A-24978, A-25062, A-25196, A-25213, A-25256, A-25259, A-25418, A-25549, A-25689, A-25690, A-25867, A-25914, A-25975, A-26085, A-26226, A-26233, A-26299, B-00107, B-00205, B-00222, B-00544, B-00568, B-00687, B-00975, B-01485, B-01493, B-01712, B-01726, B-01727, B-01796, B-01866, B-02032, B-02036, B-02053, B-02149, B-02192, B-02195, B-02206, B-02311, B-02398, B-02407, B-02424, B-02442, B-02727, B-02778, B-02908, B-02909, B-02931, B-02970, B-02971, B-03053, B-03232, B-03337, B-03581, B-03879, B-03974, B-04179, B-04200, B-04506, B-04508, B-04516, B-04634, B-04655, B-04755, B-04791, B-04842, B-05163, B-05198, B-05310, B-05454, B-05508, B-05531, B-05857, B-06136, B-06307, B-06345, B-06490, B-06697, B-06999, B-07075, B-07229, B-07359, B-07385, B-07416, B-07417, B-07466, B-07515, B-07673, B-07931, B-07962, B-08080, B-08085, B-08146, B-08155, B-08228, B-08342, B-08346, B-08348, B-08352, B-08378, B-08429, B-08470, B-08492, B-08574, B-08584, B-08713, B-08836, B-08863, B-08870, B-08908, B-08917, B-08919, B-08921, B-08922, B-08923, B-08925, B-08926, B-08936, B-08937, B-08938, B-08939, B-08940, B-08942, B-09163, B-09191, B-09195, B-09469, B-09496, B-09546, B-09600, B-09607, B-09666, B-09699, B-09788, B-09789, B-09833, B-09904, B-09905, B-09923, B-09971, B-09996, B-09999, B-10003, B-10264, B-10281, B-10336, 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B-16418, B-16425, B-16496, B-16500, B-16502, B-16510, B-16548, B-16681, B-16720, B-16731, B-16746, B-16815, B-16851, B-16862, B-16863, B-16872, B-17004, B-17124, B-17250, B-17318, B-17343, B-17531, B-17672, B-17685, B-17782, B-17979, B-18034, B-18045, B-18063, B-18110, B-18111, B-18142, B-18143, B-18154, B-18161, B-18167, B-18296, B-19029, B-19034, B-19048, B-19261, B-19346, B-19394, B-19395, B-19480, B-19482, B-19581, B-19608, B-19619, B-19629, B-19733, B-19803, B-19834, B-19845, B-19972, B-20035, B-20063, B-20082, B-20097, B-20141, B-20188, B-20243, B-20262, B-20392, B-20437, B-20526, B-20550, B-20552, B-20696, B-20738, B-20779, B-20794, B-20854, B-20914, B-21005, B-21028, B-21117, B-21136, B-21232, B-21234, B-21238, B-21268, B-21313, B-21324, B-21381, B-21504, B-21506, B-21594, B-21643, B-21720, B-21819, B-21886, B-21893, B-22001, B-22051, B-22070, B-22071, B-22103, B-22160, B-22175, B-22279, B-22291, B-22327, B-22401, B-22441, B-22500, B-22501, B-22505, B-22552, B-22559, B-22560, 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E-10220, E-10229, E-10368, E-10421, E-10608, E-10751, E-11065, E-11370, E-11514, E-11624, E-11980, E-12353, E-13965, E-14271, E-15347, E-15485, E-15511, E-16285, E-16467, E-16629, E-16687, E-16803, E-16985, E-17580, E-17595, E-17612, E-17725, E-17734, E-19503, E-19737, E-20042, E-20068, E-20163, E-20523, E-20924, E-21073, E-21099, E-21122, E-21736, E-22313, E-23163, E-23409, E-23723, E-24243, E-24341, E-24391, E-24407, E-24439, E-24486, E-24509, E-24569, E-25212, E-25229, E-25815, E-25935, E-26141, E-26267, F-00105, F-00530, F-01379, F-01380, F-02743, F-08941, F-09769, F-11257, F-13027, F-13191, F-13400, F-13487, F-13601, F-13620, F-14512, F-14686, F-14876, F-16210, F-16589, F-18185, F-24272, G-00981, G-01340, G-01865, G-02417, G-04136, G-06806, G-07039, G-07138, G-08230, G-08232, G-11437, G-11828, G-12289, G-14530, G-16192, G-16837, G-18109, G-20700, G-24021, H-00316, H-01398, H-01589, H-02293, H-02299, H-06967, H-07786, H-11733, H-19620, H-20982, I-03222, I-04622, I-07553, I-13086, I-20820, J-00166, J-00978, J-01308, J-01546, J-01659, J-01660, J-01707, J-02151, J-02918, J-06845, J-07643, J-08059, J-08867, J-11111, J-11114, J-11846, J-11995, J-12418, J-13613, J-15510, J-15889, J-16122, J-16129, J-16174, J-16506, J-17203, J-19685, J-20054, J-21241, J-23511, J-23800, J-25961, J-26193, K-00167, K-02010, K-06696, K-06778, K-09921, L-00162, L-00206, L-00311, L-00973, L-01265, L-01399, L-01585, L-01590, L-01654, L-01890, L-02011, L-02052, L-02960, L-03277, L-03359, L-03452, L-05499, L-06188, L-06615, L-06686, L-06730, L-06737, L-07550, L-07950, L-08062, L-08686, L-09073, L-09443, L-09445, L-09474, L-10166, L-10503, L-10998, L-11242, L-11266, L-11319, L-11383, L-11526, L-11781, L-12031, L-12461, L-13049, L-17321, L-17472, L-17473, L-18223, L-19062, L-21431, L-24033, L-24214, L-25688, L-26157, M-00336, M-01220, M-01221, M-08072, M-22636, M-25143, M-25193, N-00164, N-01063, N-03344, N-04212, N-05194, N-07431, N-07845, N-13513, N-13591, N-14816, N-17819, N-18206, N-21287, N-21289, N-21360, N-22794, N-23125

INERTIAL SEPARATION B-05163, B-07385, B-08155, B-19602, B-19834, B-25517

INFECTIOUS DISEASES G-08230, G-20700

INFLUENZA D-22591

INFRARED RADIATION A-13494

INFRARED SPECTROMETRY A-02631, A-05067, B-08825, B-24837, C-04889, C-22342, L-17472

INHIBITION B-10680, H-20982

INORGANIC ACIDS A-09686, A-09737, A-12633, A-15517, A-16788, A-17464, A-19017, A-21204, A-21221, A-23044, A-24817, A-25062, A-25549, A-26226, B-00135, B-00975, B-01362, B-01727, B-02195, B-02407, B-02442, B-02727, B-02931, B-02971, B-03337, B-03581, B-05198, B-06999, B-07931, B-08155, B-08342, B-08346, B-08584, B-08836, B-08863, B-09191, B-09607, B-09789, B-09833, B-09996, B-10281, B-10591, B-10968, B-11055, B-11131, B-11159, B-11233, B-11238, B-11247, B-11250, B-11253, B-11256, B-11281, B-11906, B-12092, B-13592, B-14087, B-14546, B-14730, B-15031, B-15092, B-15436, B-15976, B-16851, B-16862, B-16863, B-18034, B-19394, B-19480, B-19608, B-19733, B-20082, B-21232, B-21643, B-22057, B-22160, B-22441, B-22740, B-22809, B-22905, B-23027, B-23054, B-23221, B-23231, B-23544, B-23718, B-23867, B-23880, B-24142, B-24207, B-24643, B-24673, B-24756, B-25038, B-25071, B-25088, B-25127, B-25494, B-25503, B-25584, B-25637, B-25702, B-25743, B-26211, B-26230, C-07482, D-01790, D-04116, D-05260, D-06819, D-09591, D-22812, E-10153, E-10751, E-16985, E-24486, F-00530, G-01865, G-07138, G-08232, G-16837, G-18109, H-02299, H-05420, I-07553, I-20820, J-00166, J-01659, J-01707, J-08059, J-08867, J-11846, J-17203, K-02010, K-06778, L-00311, L-01890, L-10998, L-11242, L-11283, L-17472, L-18223, L-24033, N-04212, N-21360, N-22794

INSPECTION A-13855, A-21191, A-25690, H-06967

INSPECTORS B-00975, L-01265

INSTRUCTORS B-00975

INSTRUMENTATION A-00691, A-02633, A-02634, A-07644, A-10743, A-18056, A-19084, B-00975, B-01796, B-06999, B-07075, B-08825, B-09789, B-16862, B-18110, B-21819, C-04889, C-07941, C-08123, C-09624, C-15515, C-18012, C-19047, D-06777, D-11525, E-06373, E-11624, F-00530, F-08941

INTERMITTENT MONITORING D-08298

INTERNAL COMBUSTION ENGINES A-08392, A-08393, A-09353, A-09686, A-10183, A-10424, A-10754, A-16722, A-25549, B-04506, B-06636, B-08080, B-08584, B-10493, B-10680, B-10770, B-15544, B-19261, C-00886, D-00858, D-07393, D-09591, D-12496, F-11257, G-11828, J-00166, L-02011, L-03359, L-05499, M-25143, N-00164, N-01063, N-21289

INTERNATIONAL A-21318, A-21383, B-02036, F-00530, L-00311, L-17006, M-01567

INVERSION A-01510, A-01842, A-05506, A-10284, A-10424, A-10678, A-16073, A-16855, A-17280, A-22159, B-00687, B-00975, B-18045, B-19029, B-20550, B-23757, C-01856, C-09624, C-11340, D-02046, D-03431, D-05010, D-06777, D-06824, D-10723, E-00846, E-02410, E-04033, E-04035, E-05702, E-10229, E-10368, E-10421, E-15347, E-16803, E-20068, E-20924, E-21122, E-23723, E-24109, E-24341, E-24486, E-25075, F-00530, G-16837, G-18109, G-20700, G-21276, I-07553, J-01546, L-08686, L-11383, L-18223

IODIDES C-01363, C-23096

IODIMETRIC METHODS B-06999, C-12126, C-22885, D-22812

IODINE A-19994, A-21383, B-26220

IODINE COMPOUNDS B-04755, C-01363, C-23096, E-10608

IONIZATION B-06307, B-07931, B-10704, C-25260

IONS B-07931, B-22560

IOWA A-01489, C-07516, M-01221

IRON A-00972, A-08392, A-09686, A-09737, A-13261, A-17199, B-02036, B-03232, B-03581, B-03974, B-04755, B-05531, B-07931, B-09789, B-09833, B-10770, B-11240, B-11985, B-16681, B-16863, B-21324, B-23376, B-23955, B-24697, B-24881, D-00657, D-07951, D-09591, D-23326, G-01340, G-08232, I-07553, I-13086, J-01659, L-00973, L-08062, L-24214, N-07431, N-21287, N-22794

IRON COMPOUNDS A-05067, A-09831, A-16788, A-19017, A-25545, B-00222, B-00564, B-01866, B-03337, B-03581, B-04842, B-08898, B-10968, B-11240, B-11910, B-11929, B-14838, B-18111, B-19692, B-19804, B-19972, B-20223, B-22127, B-23374, B-23526, B-24253, B-24609, B-25744, C-07516, C-23096, D-07951, D-09591, F-02743, F-13573, F-14814, F-16883, F-18185, I-04622, I-11286, L-10998, N-04432, N-07431

IRON OXIDES A-13261, A-13401, B-03232, B-03581, B-04842, B-05531, B-05868, B-08908, B-08919, B-08939, B-08942, B-09600, B-09833, B-22279, B-25744, C-16734, E-16985, F-08943, F-11163, I-07553, J-01546, J-01659, J-11846, N-04432, N-07431

IRRADIATION CHAMBERS E-11624

ISOTOPES A-08388, A-17052, A-17483, A-17542, A-21383, A-23239, A-25914, B-04755, C-23377, D-25476, F-11257, J-07643

ITALY B-10336, B-16510, B-19724, B-20738, B-22884, B-25427, D-08298, K-22248

J

JAPAN A-06040, A-13293, A-13644, A-15620, A-17184, A-17199, A-17398, A-17542, A-21191, A-24500, A-24508, A-24535, A-24817, A-25062, A-25690, A-25914, B-02149, B-04655, B-10563, B-10692, B-11252, B-12417, B-12442, B-13721, B-14087, B-14194, B-14261, B-14394, B-15092, B-15251, B-15692, B-15693, B-15738, B-15841, B-15844, B-16346, B-16548, B-16872, B-17250, B-17343, B-17392, B-19581, B-19972, B-20097, B-20262, B-20392, B-20526, B-21275, B-21324, B-21643, B-22160, B-22291, B-23146, B-23262, B-23447, B-24207, B-24269, B-24589, B-24643, B-24673, B-24707, B-24826, B-25019, B-25071, B-25088, B-25284, B-25702, C-07482, C-07721, C-12126, C-16149, C-17468, C-22391, D-05428, D-07393, D-07951, E-17595, E-17725, E-17734, E-19503, E-20068, E-23163, E-26141, F-00530, F-16376, F-17594, F-24272, G-16837, G-23151, I-03222, L-09445, L-09474, L-24214, N-04212, N-13591

JET AIRCRAFT B-10680, B-12672, J-13613, L-03359, N-00164

K

KANSAS A-01489, C-07516, J-11111, M-01221

KENTUCKY A-01489, B-01866, B-06297, C-07516, C-18012, L-01590, L-09443, L-11185, L-11781

KEROSENE A-00943, A-18052, A-25213, B-10680, F-00530, H-02299

KETONES B-08352, B-12503, C-21663

KILNS A-00972, A-08392, A-25196, A-25549, B-03232, B-07931, B-09904, B-11055, B-14057, B-24881, B-25139, B-26063, D-12496, D-13176, J-15889, K-09921, N-21287

KONIMETERS C-17474, D-06755

KRAFT PULPING A-09686, A-15517, A-25213, B-09789, B-16681, C-16875, G-11828, G-16837, J-16174, J-21241, L-06730, L-08062, L-11526, L-19062

L

LABORATORY ANIMALS D-02818, F-00530, G-01865, G-04136, G-08232, G-11300, G-21276, H-02299, I-20820, J-00166, L-00311, L-03359, L-03452, N-04212

LABORATORY FACILITIES A-10183, B-01245, B-10165, B-14566, C-13477, L-01265

LAKES A-07645, E-10053, E-10153

LANDFILLS A-09737, A-10740, A-11981, A-22875, B-16746, D-00858, D-09591

LAPSE CONDITION E-04035, E-20924, E-21122

LARYNX F-00530

LASERS C-09624, C-15925, D-06777, E-15483

LAUNDERING (COAL) A-10442, B-03337, B-05198, B-11215, B-13835, B-23682, B-24609, F-02743

LAUNDRIES B-09833, N-04212

LEAD A-09686, B-00107, B-11238, B-21324, D-05551, D-09591

LEAD COMPOUNDS A-05067, A-06351, A-09831, A-21383, A-23239, B-03232, B-03337, B-09788, B-11238, C-23096, D-05260, D-05428, D-05551, D-09591, E-24109, H-19620, K-02010, K-06778, L-00311, L-17472, L-24214, N-04212

LEAD PEROXIDE CANDLE B-02311, C-00886, D-00657, D-02818, E-03251, E-25815, G-00981, G-02417, G-21276, L-03277, L-09445

LEATHER B-08155, B-09788, I-07553

LEAVES F-00530, H-00316, H-02299, H-05420

LEGAL ASPECTS A-05530, A-06040, A-07642, A-09353, A-10442, A-11739, A-14574, A-16073, A-19434, A-21221, A-24535, A-24732, A-25975, B-00107, B-00975, B-02032, B-02407, B-02772, B-04516, B-06278, B-06345, B-06999, B-08348, B-08917, B-10493, B-13394, B-14270, B-16720, B-16731, B-16815, B-18143, B-18290, B-19471, B-22051, B-22559, B-24826, B-25164, C-07787, D-03431, E-10368, E-25075, F-00530, G-08230, G-08232, G-24021, H-01589, H-06967, J-00253, J-02151, J-07643, J-08059, J-16506, J-19685, K-02010, K-06696, K-06778, L-00162, L-00206, L-00311, L-00973, L-01265, L-01399, L-01585, L-01590, L-01654, L-01890, L-02011, L-02831, L-03359, L-06615, L-06730, L-06735, L-06737, L-06739, L-07550, L-07794, L-07950, L-08062, L-09443, L-09474, L-10166, L-11185, L-11266, L-11319, L-11383, L-11781, L-13049, L-14535, L-17473, L-18121, L-18220, L-18223, L-20698, L-24033, L-25688, L-26157, M-01220, M-01221, M-01567, M-25193, N-03344, N-07845, N-17819, N-21287, N-21360

LEGISLATION A-09353, A-10442, A-11739, A-16073, A-24535, B-00975, B-02407, B-06278, B-06999, B-10493, B-13394, B-14270, B-18143, B-18290, B-19471, B-22051, B-25164, E-25075, F-00530, G-08230, G-08232, H-01589, H-06967, J-00253, J-02151, J-19685, K-02010, K-06778, L-00162, L-00206, L-00311, L-00973, L-01590, L-01654, L-01890, L-02011, L-03359, L-06615, L-07950, L-08062, L-09443, L-09474, L-11319, L-13049, L-14535, L-18121, L-18220, L-20698, L-24033, L-25688, M-01221, M-01567, N-07845, N-21360

LEUKEMIA A-19994
LIFE SPAN A-19994
LIGHT RADIATION A-05067, A-13494, A-18056, A-25213, A-25418, C-04040, C-09624, C-23350, D-06777, E-23723, E-24109, F-01379, F-11257, H-05420, J-07643, N-07845
LIGHT SCATTERING B-05868, B-24837, C-03546, C-04759, C-09624, C-11193, C-19519, E-16803
LIME A-08392, B-07931, B-11055, B-14057
LIMESTONE A-21221, A-24978, B-00544, B-04842, B-05454, B-06136, B-07430, B-07466, B-08342, B-08346, B-08347, B-08429, B-08825, B-08917, B-09600, B-09666, B-09788, B-09833, B-10681, B-10968, B-11178, B-11240, B-11847, B-11854, B-12308, B-12581, B-12797, B-15284, B-15436, B-15489, B-15572, B-15946, B-16248, B-19340, B-19619, B-19642, B-19845, B-19972, B-20392, B-20539, B-20995, B-21275, B-24253, F-09967, F-11782, I-07553, J-08867, L-06737, L-19062, N-04432
LINE SOURCES E-00023, E-01261, E-04033, E-04034, E-11514
LIQUIDS A-09165, A-10740, A-16410, A-22159, A-24916, B-02971, B-03337, B-03974, B-04755, B-08574, B-08919, B-08936, B-08939, B-08940, B-09191, B-09833, B-09904, B-09971, B-10165, B-11131, B-12503, B-15962, B-16496, B-19373, B-19876, B-20779, B-22615, B-22702, B-22871, B-23376, B-23447, B-23526, B-24001, B-24643, B-24785, B-25079, B-25186, B-25320, C-22391, C-23121, E-10153, F-00105, F-01852, F-04939, F-08943, F-10429, F-14390, F-14512, I-04622, I-07553
LITHIUM COMPOUNDS A-06351, A-08388, B-22327, B-22756, B-23376
LITIGATION J-08059
LOCAL GOVERNMENTS A-24535, B-00975, D-03432, K-00167, L-00162, L-00206, L-06615, L-07950, L-09443, L-11266, L-18220
LONDON A-09353, A-16855, A-16877, B-08574, D-02057, E-08400, E-11514, E-25075, G-06826, G-08230, G-08232, G-16837, G-18109, N-04212, N-07845
LOOPING C-11340
LOS ANGELES B-00107, B-00975, B-04516, B-09833, B-21594, D-07393, L-00973, L-01585, L-11266, L-18223, N-04212
LOUISIANA K-00167, L-06188, M-01221
LOWER ATMOSPHERE A-17280, A-25213, B-15616, B-22884, C-23377, D-06777, E-05702, E-06373, E-06775, E-10229, E-10368, E-11980, E-16629, E-16985, E-17734, E-20042, E-20924, E-21073, E-21099, E-21122, E-21986, E-26141
LUNG CANCER E-25075, G-23670, G-24021, L-03359, N-21289
LUNG CLEARANCE A-16855, G-06806
LUNGS A-16855, F-00530, G-04136, G-06806, G-07138, G-11437, G-18109

M

MAGNESIUM B-00107, B-03581, F-14512
MAGNESIUM COMPOUNDS A-09831, B-00544, B-03337, B-03581, B-03974, B-04842, B-08470, B-08919, B-08937, B-08939, B-09163, B-09191, B-09600, B-09833, B-10591, B-11854, B-12797, B-14394, B-15244, B-15976, B-19619, B-19670, B-22883, B-23822, B-24190, B-25584, B-25744, F-04827, F-04939, F-08943, F-09967, F-11163, I-11286, J-08867, N-04432
MAGNETIC SEPARATION A-06978, B-00564, B-05454, B-07425, B-08898, B-09666, B-09996, B-11262, B-12091, B-13051, B-13856, B-18111, B-19804, B-22127, F-02743, L-01590, L-13049
MAGNETOHYDRODYNAMICS (MHD) A-03072, A-04287, A-07644, A-07647, A-07793, A-09165, A-10442, A-11739, A-12266, A-14378, A-16949, A-18176, A-19024, A-20736, A-21204, A-22649, A-23359, A-23379, A-23954, A-24508, A-24955, A-26085, B-08228, B-09996, B-11191, B-11262, B-17124, B-21005, B-21381, B-23176, F-00105, G-07138, N-05194
MAINE L-09443
MAINTENANCE A-03587, A-10743, B-05162, B-05853, B-07466, B-07673, B-09788, B-09833, B-10264, B-11233, B-14707, B-22501, B-22671, B-25127, B-25164, B-25833, L-10503
MALES G-11339, G-18109, G-23670
MANAGEMENT PERSONNEL L-09073
MANGANESE B-08713, B-10770, D-09591
MANGANESE COMPOUNDS A-05067, A-06351, A-16788, B-02407, B-03337, B-07962, B-08346, B-08347, B-08713, B-08908, B-11252, B-14566, B-24253, B-24589, B-24613, B-24673, B-25416, D-05551, D-09591, N-04432
MANGANESE DIOXIDE (JAPANESE) B-00135, B-01362, B-02407, B-04655, B-06636, B-08346, B-08347, B-08836, B-09666, B-10563, B-10968, B-11252, B-11910, B-12253, B-12442, B-13721, B-14566, B-16346, B-16425, B-16548, B-16851, B-16872, B-20262, B-20526, B-22809, B-22883, B-23373, B-24207, B-24589, B-24707, B-25584, B-25702, F-13487, J-08867
MANGANESE SULFATES A-16788, B-24613
MAPPING A-10678, D-10723, D-11525, E-11514, J-11111
MARYLAND A-01489, B-06297, C-07516, L-01590, L-09443
MASS SPECTROMETRY A-22144, A-23239, B-11131, C-23377, F-10429
MASS TRANSPORTATION L-07550, N-17819
MASSACHUSETTS E-11624
MATERIALS DETERIORATION A-19017, A-21999, A-23359, A-24005, B-00975, B-03337, B-03974, B-05853, B-06999, B-07466, B-08085, B-08836, B-09191, B-09607, B-09833, B-10680, B-10681, B-12581, B-13639, B-14394, B-14838, B-15572, B-16863, B-18296, B-20082, B-21643, B-22110, B-22327, B-22740, B-23376, B-24697, B-25637, B-25677, D-03432, D-03514, D-06755, F-14876, F-16883, G-08232, I-04622, I-07553, I-11286, I-13086, I-20820, J-00166, L-00311, L-01265, L-03452, L-11266, N-00164, N-22794
MATHEMATICAL ANALYSES A-10183, A-11502, A-12285, A-13330, A-13401, A-15701, A-16788, A-21383, A-23170, A-24915, A-25914, A-26226, B-00544, B-00687, B-01796, B-06307, B-06543, B-07674, B-07931, B-08085, B-08870, B-09469, B-09523, B-09788, B-09923, B-09971, B-10003, B-14269, B-14981, B-19834, B-22861, B-23974, C-02655, C-02668, C-05216, C-11340, C-14733, C-22511, C-22982, C-25260, D-02953, D-02979, D-06777, D-09984, D-10723, D-11525, E-00846, E-01261, E-01934, E-03557, E-05357, E-05702, E-06373, E-06775, E-07428, E-10010, E-10219, E-10368, E-10421, E-10608, E-10751, E-11065, E-11370, E-11980, E-12353, E-14271, E-15511, E-16629, E-16687, E-17580, E-17612, E-17725, E-19503, E-19737, E-20042, E-20163, E-20523, E-21736, E-23163, E-24243, E-24341, E-24569, E-25935, F-00530, F-09064, F-10429, F-11722, F-14390, F-16883, I-04622, J-01679, J-11111, J-15510, J-15889, K-21896, K-22248, L-11266, L-26157
MATHEMATICAL MODELING A-15701, A-16788, A-23170, A-26226, B-00544, B-01796, B-06543, B-09469, B-09971, B-14269, B-14981, B-19834, B-22861, C-02668, C-11340, C-22511, D-09984, D-10723, D-11525, E-01934, E-05702, E-06775, E-07428, E-10010, E-10219, E-10421, E-10608, E-10751, E-11065, E-11370, E-14271, E-16629, E-17580, E-19737, E-20042, E-20163, E-20523, F-09064, J-01679, J-15510, J-15889, K-21896, L-11266, L-26157
MAXIMUM ALLOWABLE CONCENTRATION A-03587, A-10442, A-13219, A-16855, A-16887, A-21916, A-25549, A-25975, B-00975, B-02032, B-02424, B-06999, B-09833, B-10493, D-02953, D-02979, D-06819, D-07141, E-11370, E-23163, G-02417, G-08232, J-02151, K-06696, K-06778, L-00206, L-00311, L-00973, L-06188, L-09474, L-10166, L-24214, N-21289
MBTH METHOD E-11624
MEASUREMENT METHODS A-01510, A-02860, A-05067, A-07570, A-11502, A-13848, A-15620, A-18114, A-18171, A-19084, A-21999, A-25914, A-25975, B-00564, B-00975, B-02311, B-02407, B-04200, B-06490, B-06999, B-07359, B-08155, B-08713, B-08825, B-09971, E-10165, B-13394, B-14159, B-16240, B-18110, B-18296, B-22051, B-22071, B-22740, B-24837, B-25164, B-25323, B-25637, C-00886, C-01363, C-01856, C-01857, C-03546, C-04040, C-04759, C-04889, C-06095, C-07516, C-07721, C-07787, C-08123, C-09624, C-11755, C-14733, C-15348, C-15479, C-15515, C-15925, C-16364, C-16734, C-16860, C-16875, C-17468, C-17474, C-18012, C-19047, C-19519, C-21663, C-22342, C-22391, C-22885, C-23121, C-23350, C-24245, C-24412, C-25260, D-00657, D-02046, D-02818, D-03514, D-06755, D-06777, D-08298, D-08858, D-09591, D-11525, D-23356, E-03251, E-04034, E-06823, E-07580, E-08400, E-11065, E-15483, E-16285, E-16803, E-17734, E-21099, E-25212, E-25815, E-26141, F-00530, F-01852, F-02743, F-07059, F-08941, F-11135, F-15714, G-00981, G-02417, G-08230, G-21276, H-06967, K-09921, L-02052, L-02960, L-03277, L-08686, L-09445, L-17472, L-17473, N-21360

MEMBRANE FILTERS A-19994, B-22615, C-00886, C-04040, C-23096, C-26139, D-06755, D-22812, E-11624, G-21276
MERCAPTANS A-13978, B-20550, B-26211, D-09591
MERCURY B-11238
MERCURY COMPOUNDS A-06351, B-11238, L-24214
METABOLISM H-20982
METAL COMPOUNDS A-03113, A-05067, A-06351, A-06978, A-07800, A-08388, A-09161, A-09165, A-09686, A-09831, A-10442, A-13401, A-16788, A-16887, A-17052, A-18276, A-19017, A-20863, A-21383, A-21999, A-22867, A-23170, A-23239, A-23359, A-24978, A-25259, A-25545, A-25914, B-00135, B-00222, B-00544, B-00564, B-01866, B-02407, B-03045, B-03232, B-03337, B-03581, B-03879, B-03974, B-04755, B-04842, B-05454, B-06543, B-07752, B-07962, B-08080, B-08346, B-08347, B-08429, B-08470, B-08492, B-08574, B-08713, B-08825, B-08836, B-08898, B-08908, B-08917, B-08919, B-08936, B-08937, B-08938, B-08939, B-08940, B-08942, B-09163, B-09191, B-09600, B-09788, B-09833, B-09904, B-09971, B-10591, B-10681, B-10692, B-10770, B-10968, B-11055, B-11191, B-11238, B-11240, B-11252, B-11854, B-11910, B-11929, B-11996, B-12672, B-12797, B-13569, B-13817, B-14087, B-14394, B-14566, B-14838, B-15244, B-15692, B-15976, B-16731, B-18111, B-19339, B-19340, B-19619, B-19670, B-19692, B-19804, B-19876, B-19972, B-20223, B-22103, B-22127, B-22327, B-22756, B-22809, B-22883, B-23027, B-23374, B-23376, B-23504, B-23526, B-23544, B-23822, B-23880, B-24048, B-24142, B-24190, B-24253, B-24270, B-24565, B-24589, B-24609, B-24613, B-24673, B-24697, B-25416, B-25430, B-25494, B-25503, B-25584, B-25743, B-25744, B-25787, B-26084, C-01363, C-07516, C-23096, D-05260, D-05428, D-05551, D-07951, D-09591, E-10010, E-24109, F-02743, F-04827, F-04939, F-08943, F-09769, F-09967, F-11163, F-13400, F-13573, F-14814, F-16376, F-16883, F-18185, G-08232, H-00316, H-06967, H-19620, I-04622, I-07553, I-11286, J-07643, J-08867, K-02010, K-06778, L-00311, L-10503, L-10998, L-17472, L-24214, N-04212, N-04432, N-07431, N-13513
METAL FABRICATING AND FINISHING A-08392, A-09737, A-15517, A-17199, A-17464, A-22867, B-00975, B-02053, B-02407, B-16681, B-20188, B-20552, B-21117, B-21324, B-25047, B-25913, B-26063, C-17468, D-00858, D-03431, D-12496, E-07428, F-14512, G-01340, H-02299, J-21241, J-26193, K-02010, L-00311, L-01890, L-08062
METALS A-00972, A-03113, A-08392, A-09686, A-09737, A-10442, A-13261, A-13978, A-17199, A-22867, B-00107, B-02036, B-03232, B-03337, B-03581, B-03974, B-04755, B-05531, B-06999, B-07931, B-08492, B-08713, B-09788, B-09789, B-09833, B-10770, B-11238, B-11240, B-11906, B-11985, B-15251, B-16681, B-16863, B-21232, B-21324, B-23376, B-23955, B-24697, B-24881, C-03592, D-00657, D-03514, D-05551, D-07951, D-09591, D-23326, F-00105, F-14512, F-17592, G-01340, G-08232, H-00316, I-07553, I-11286, I-13086, J-01659, J-16174, L-00973, L-08062, L-24214, N-07431, N-21287, N-22794
METEOROLOGICAL INSTRUMENTS A-00691, B-22884, C-16364, D-23957, E-00023, E-03557, E-04033, E-10053, E-10368, E-10421, E-11065, E-26141, L-02960
METEOROLOGY A-00691, A-01350, A-01510, A-01842, A-02765, A-05506, A-10424, A-10678, A-10754, A-12335, A-16073, A-16788, A-16887, A-17483, A-22159, A-24500, B-00140, B-00687, B-00975, B-01485, B-01796, B-02407, B-04200, B-05531, B-06835, B-06999, B-10680, B-11131, B-16863, B-17531, B-18045, B-18110, B-20550, B-20779, B-21819, B-22051, B-22500, B-22884, B-23331, B-23974, B-24001, B-24681, B-24826, B-25186, B-25187, B-25298, B-26220, C-01856, C-02668, C-04040, C-05216, C-09624, C-11340, C-15925, C-16149, C-16364, C-20224, C-22511, C-23350, C-24412, C-26139, D-02046, D-02818, D-02953, D-02979, D-03431, D-03514, D-05010, D-06777, D-08858, D-09591, D-09984, D-10723, D-11525, D-23356, E-00023, E-00846, E-01259, E-01260, E-01261, E-01934, E-02410, E-03251, E-03557, E-04033, E-04034, E-04035, E-05357, E-05702, E-06373, E-06775, E-06823, E-06827, E-07428, E-07843, E-08400, E-10010, E-10053, E-10153, E-10219, E-10220, E-10229, E-10368, E-10421, E-10608, E-10751, E-11065, E-11370, E-11514, E-11980, E-13965, E-14271, E-15178, E-15483, E-15511, E-16285, E-16467, E-16629, E-16687, E-16803, E-16985, E-17580, E-17595, E-17734, E-19503, E-19737, E-20042, E-20924, E-21099, E-21122, E-21736, E-21986, E-22313, E-23163, E-23409, E-23723, E-24109, E-24341, E-24391, E-24407, E-24439, E-24486, E-25212, E-25229, E-25815, E-26267, F-00530, F-01379, F-04939, F-11257, G-00981, G-02417, G-06826, G-08230, G-08232, G-11828, G-16837, G-18109, G-20700, G-21276, H-02293, H-02299, H-05420, H-06967, H-11733, I-07553, L-00206, L-01265, L-01654, L-01890, L-02011, L-03277, L-03359, L-08686, L-09445, L-11266, L-11383, L-12461, L-18223, L-25688, L-26157, N-04212, N-17819, N-23125
METHANES A-00532, A-08390, A-08391, A-09831, A-17017, B-03337, B-04179, B-06543, B-09195, B-13636, B-19373, B-25503, F-10422, F-10429, F-13766, F-22319, F-22587
MEUSE VALLEY A-16855, D-07393, G-16837
MICE I-20820
MICHIGAN K-00167, L-00973
MICROMETEOROLOGY E-16467
MICROORGANISMS B-00222, B-02149, B-06062, B-07425, D-22812, G-08230, I-07553
MICROSCOPY A-00532, A-02631, A-18114, B-01866, C-08123, C-16734, C-23121, F-08943, F-14814
MIDDLE ATMOSPHERE E-17595
MINERAL PROCESSING A-00943, A-00972, A-02549, A-07642, A-08388, A-08391, A-08392, A-09161, A-09737, A-10740, A-13053, A-13410, A-14701, A-19434, A-21221, A-22867, A-22875, A-25213, B-00107, B-00975, B-01712, B-02036, B-03337, B-04179, B-05531, B-06307, B-07385, B-07416, B-07931, B-10281, B-12417, B-15692, B-15693, B-16720, B-18063, B-19261, B-19733, B-20188, B-22001, B-22279, B-22809, B-24756, B-25047, B-25139, B-26063, C-04759, C-11842, C-15515, C-18012, C-21663, C-25260, C-25872, D-03431, D-05260, D-23326, E-10368, F-00530, F-13027, G-04136, G-06806, G-07039, G-11828, G-14530, H-02299, H-19620, J-01659, J-15889, J-16174, J-17203, J-21241, J-26193, L-01890, L-06730, M-01220, M-01221, M-08072, M-22636, N-00164
MINERAL PRODUCTS A-21221, A-24978, B-00544, B-00975, B-04842, B-05454, B-06136, B-07430, B-07466, B-08342, B-08346, B-08347, B-08429, B-08825, B-08917, B-09600, B-09666, B-09788, B-09789, B-09833, B-09904, B-10165, B-10281, B-10681, B-10968, B-11178, B-11240, B-11847, B-11854, B-12308, B-12581, B-12797, B-15284, B-15436, B-15489, B-15572, B-15946, B-16248, B-19261, B-19340, B-19619, B-19642, B-19845, B-19972, B-20392, B-20539, B-20995, B-21275, B-22001, B-23146, B-24253, C-01363, C-08123, D-09591, F-04827, F-09967, F-11782, F-14814, G-11300, I-07553, J-08867, L-06737, L-14598, L-19062, N-04432
MINING A-02549, A-07642, A-08388, A-08391, A-09161, A-10740, A-13053, A-14701, A-22875, B-01712, B-04179, B-06307, B-10281, B-18063, B-19261, B-22809, B-25047, C-04759, C-11842, C-15515, C-25260, C-25872, F-13027, G-04136, G-06806, G-07039, G-14530, H-19620, J-01659, J-26193, M-01220, M-01221, M-08072, M-22636, N-00164
MINNESOTA A-01842, A-09161, A-11789, M-01221
MISSILES AND ROCKETS A-19994
MISSOURI A-01489, A-02630, A-02631, A-02633, A-03072, A-10754, B-00567, B-00653, B-01485, B-01615, B-01866, B-02206, B-02727, B-02970, B-03053, B-03337, B-03879, B-03974, B-04655, B-06297, B-24681, C-01354, C-01857, C-02655, C-04040, C-07516, D-00858, E-00023, F-00530, F-01379, F-02743, J-11111, K-00167, L-00973, L-01890, L-09443, L-11185, L-11781, M-01221, N-02632
MISTS B-03045, B-04755, B-09789, B-09833, B-11233, B-11238, D-09591, E-16803, F-00530, G-01865, N-04212
MOBILE C-17419, E-25815, F-11257, L-08686
MOLYBDENUM D-09591
MOLYBDENUM COMPOUNDS A-05067, A-06351, A-09831, B-25744, D-09591
MONITORING A-01510, A-15620, A-19084, A-25914, A-25975, B-04200, B-06999, B-07359, B-14159, B-16240, B-22051, B-24837, B-25164, B-25323, B-25637, C-01363, C-01856, C-01857, C-04889, C-09624, C-15479, C-15515, C-15925, C-17468, C-22342, C-22885, C-23350, C-24412, C-25260, D-02046, D-02818, D-08298, D-08858, D-11525, E-08400,

E-17734, E-21099, E-25212, E-25815, F-08941, G-08230, H-06967, L-02052, L-02960, L-08686, L-09445, L-17472, L-17473, N-21360
MONTANA A-01489, C-07516, M-01220, M-01221
MONTHLY A-10424, A-14997, D-02818, D-06819, D-09591, D-16237, E-01259, L-09445
MORBIDITY F-00530, G-00981, G-07138, G-08230, G-16837, G-20700, G-21276, G-23151, N-21360
MORTALITY B-17124, E-10153, E-25075, F-00530, G-00981, G-08230, G-11339, G-16837, G-18109, G-20706, G-21276, I-20820, L-11266, N-21360
MOTTLING H-05420
MOUNTAINS A-07645, B-18045, B-22884
MULTIPLE CHAMBER INCINERATORS A-10678, B-26063, L-06730, M-00336

N

NAPHTHALENES A-13494, F-10429
NASHVILLE B-04200, D-04116, F-00530
NATIONAL AIR SAMPLING NETWORK (NASN) D-06755, D-09591
NATURAL GAS A-00972, A-07647, A-08388, A-08390, A-08391, A-09169, A-09737, A-09831, A-10424, A-10442, A-10678, A-11739, A-11789, A-12285, A-13785, A-13954, A-13963, A-14794, A-14980, A-15391, A-16239, A-16888, A-17051, A-17910, A-18052, A-18056, A-18276, A-19511, A-20736, A-20863, A-21318, A-23726, A-23753, A-24817, A-25062, A-25213, A-25256, A-25259, A-25867, A-26085, B-00107, B-04200, B-04516, B-06543, B-08348, B-09666, B-10655, B-11247, B-11262, B-13394, B-15358, B-19733, B-21268, B-21594, B-22559, B-22809, B-23447, B-23718, B-23880, D-01790, D-03431, D-05010, D-09591, D-12496, D-22812, E-23723, F-01379, F-01380, F-13400, F-16210, J-13613, L-07550, L-11266, L-11526, L-12461, L-17321, L-18223, M-01220, M-01221, M-25188, N-06133, N-13591, N-21289
NEBRASKA M-01221
NECROSIS H-02299, H-05420
NEUTRAL CONDITION E-04034, E-04035, E-07801, E-10421, E-21073
NEUTRON ACTIVATION ANALYSIS B-04755, C-25231, F-08941
NEVADA K-00167, M-01220, M-01221
NEW HAMPSHIRE G-16837
NEW JERSEY B-06697, B-15148, D-09591, E-06775, H-05420, J-07643, K-06696, L-00973, L-01585, L-02831, L-09443
NEW MEXICO A-01489, C-07516, C-16875, L-11185, L-11781, M-01220
NEW ORLEANS L-06188
NEW YORK CITY B-04506, B-04516, B-08348, B-11251, B-25187, D-06824, D-09591, G-18109, J-00253, J-11114, K-00167, L-00973, L-01265, L-03359, L-05105, L-06188, L-08686, L-09073, L-11266, L-18121, L-18223, N-04212
NEW YORK STATE A-04937, A-09482, A-16887, B-03974, B-04506, B-04516, B-08348, B-11251, B-25187, D-05010, D-06824, D-09591, G-11339, G-18109, J-00166, J-00253, J-11114, K-00167, L-00973, L-01265, L-01585, L-03359, L-05105, L-06188, L-08686, L-09073, L-09443, L-11266, L-18121, L-18223, N-04212
NICKEL A-22867, B-03581, D-07951, D-09591
NICKEL COMPOUNDS A-05067, A-06351, A-09831, A-22867, B-09833, B-25744, D-07951, D-09591
NITRATES A-16722, A-23359, B-06636, B-25416, C-01363, C-23096, G-20700, G-21276, H-00316, H-02299, H-05420, L-09445
NITRATION F-10422
NITRIC ACID A-09686, A-21204, A-26226, B-21232, B-23880, D-05260, G-07138, J-17203, K-06778, L-11242
NITRIC OXIDE (NO) A-05011, A-09831, A-16722, A-17357, A-22875, A-23359, A-26226, B-00107, B-00140, B-00975, B-01362, B-04200, B-04634, B-05857, B-06636, B-09833, B-10336, B-13394, B-17782, B-21232, B-22756, B-23880, C-00886, C-11755, C-22391, F-18185, G-20700, G-21276, H-06967, L-09445, N-00164, N-07845
NITROGEN B-13636, B-15962, B-18111, B-19373, B-24019, C-13477, F-01852, F-09769, F-10422, F-11163, H-05420
NITROGEN DIOXIDE (NO2) A-00532, A-01842, A-05011, A-09686, A-09831, A-11619, A-16722, A-16855, A-17357, B-00107, B-00140, B-00975, B-01362, B-03045, B-04200, B-08584, B-09833, B-10336, B-21232, B-23880, B-26220, C-00886, C-07482, C-11755, C-22391, D-00858, D-05010, D-05428, D-22812, G-20700, G-21276, H-05420, H-06967, K-06778, L-01890, L-03359, L-07550, L-09445, M-00336, N-00164, N-04212
NITROGEN OXIDES A-00532, A-00972, A-01842, A-03072, A-03113, A-05011, A-05067, A-09686, A-09737, A-09831, A-10442, A-10754, A-11619, A-12619, A-14997, A-15620, A-16722, A-16855, A-16887, A-17357, A-19318, A-21204, A-22649, A-22875, A-23359, A-23379, A-23726, A-24039, A-24732, A-25213, A-26226, B-00107, B-00140, B-00687, B-00975, B-01362, B-02908, B-03045, B-04200, B-04516, B-04634, B-05857, B-06636, B-07075, B-07430, B-08080, B-08584, B-09666, B-09833, B-10336, B-10493, B-10591, B-11159, B-11229, B-11262, B-12040, B-13394, B-14159, B-14632, B-16248, B-16502, B-17782, B-18110, B-19034, B-19340, B-19471, B-21232, B-21234, B-21268, B-21594, B-22559, B-22740, B-22756, B-22861, B-23880, B-24073, B-24678, B-24837, B-24922, B-25427, B-25517, B-26220, C-00886, C-03592, C-07482, C-11755, C-16860, C-17419, C-21663, C-22391, D-00858, D-01790, D-03514, D-05010, D-05428, D-12496, D-22812, E-07843, E-25075, F-18185, G-07138, G-11828, G-20700, G-21276, H-00316, H-02299, H-05420, H-06967, H-07786, J-01546, J-15889, J-17203, K-02010, K-06778, L-00311, L-01654, L-01890, L-03359, L-06188, L-07550, L-09445, L-09474, L-24033, M-00336, M-25188, N-00164, N-04212, N-07845, N-21289, N-21360
NITROUS ACID C-07482
NITROUS ANHYDRIDE (N2O3) N-04212
NITROUS OXIDE (N2O) B-10336, C-11755
NON-INDUSTRIAL EMISSION SOURCES A-00532, A-00943, A-00972, A-05169, A-07642, A-07647, A-07793, A-08392, A-08393, A-09353, A-09686, A-09737, A-09831, A-10183, A-10442, A-10678, A-10740, A-10743, A-10754, A-11411, A-11413, A-11619, A-11637, A-11640, A-11655, A-11968, A-11981, A-11982, A-11988, A-12285, A-13855, A-14400, A-14574, A-14701, A-14997, A-15517, A-16073, A-16212, A-16722, A-16949, A-17184, A-17357, A-17464, A-18052, A-19434, A-19511, A-19994, A-21191, A-21204, A-21383, A-22418, A-22875, A-23619, A-23652, A-23884, A-24535, A-24732, A-25259, A-25549, A-25690, A-26299, B-00975, B-01187, B-01245, B-01799, B-02192, B-02398, B-02772, B-02974, B-03053, B-04506, B-04516, B-06835, B-06999, B-07466, B-08080, B-08085, B-08347, B-08584, B-08836, B-08938, B-09469, B-09788, B-09833, B-09905, B-09996, B-10281, B-10336, B-10591, B-11238, B-12581, B-15572, B-15933, B-16746, B-16815, B-18063, B-18110, B-18296, B-19602, B-20188, B-21268, B-24142, B-24168, B-24613, B-24954, B-25038, B-25170, B-25427, B-25584, C-00886, C-07848, C-09624, C-16875, C-18012, C-24245, D-00858, D-02057, D-03431, D-03432, D-04116, D-05010, D-05428, D-07393, D-07951, D-08298, D-08858, D-09591, D-09984, D-12496, E-08400, E-10153, E-11065, E-11514, E-15347, E-19737, E-25075, F-00530, F-13620, G-08230, G-08232, G-11828, G-18109, H-01398, H-02293, H-06967, H-07786, H-11733, I-07553, J-00978, J-01308, J-01546, J-07643, J-08059, J-11111, J-13613, J-21241, J-26193, L-00206, L-00311, L-00973, L-01265, L-01585, L-01590, L-01890, L-02011, L-02831, L-03359, L-03452, L-05105, L-05499, L-07550, L-07950, L-08062, L-09073, L-09474, L-10166, L-11242, L-11266, L-11526, L-11781, L-18121, L-20698, L-24214, L-25688, L-26157, M-00336, M-08072, M-22636, M-25193, N-00164, N-01063, N-04212, N-07845, N-18206, N-21287, N-21289, N-23125
NON-URBAN AREAS A-01510, A-10754, B-11906, D-02046, D-12496, E-06775, E-11514, E-25075, F-00530
NORTH DAKOTA A-01489, A-02633, A-09161, C-07516, L-11185, L-11781, M-01221
NUCLEAR EXPLOSIONS A-17483
NUCLEAR POWER PLANTS A-01480, A-05530, A-07642, A-07644, A-07647, A-07800, A-08388, A-10442, A-11739, A-12088, A-13292, A-13316, A-13479, A-13892, A-13954, A-14378, A-16239, A-16489, A-16492, A-16855, A-16887, A-17052, A-17464, A-17483, A-17542, A-18056, A-18078, A-18176, A-18177, A-18276, A-19024, A-19165, A-19318, A-19434, A-19994, A-20736, A-20863, A-21191, A-21916, A-23170, A-23379, A-23619, A-23652, A-23753, A-23954, A-24951, A-25256, A-25259, A-25867, A-25914, A-25975, A-26085, B-04506, B-04755, B-08917, B-11262, B-14159, B-19346, B-20437, B-21232, B-21381, B-24001, B-25529, B-26220, C-01363, C-11755, C-16364, C-22511, C-25231,

D-25476, E-02410, E-05702, E-10608, E-14271, E-21073, E-24391, E-24407, E-24509, E-24569, E-25935, F-11257, F-13400, F-14512, G-01865, H-00316, H-11733, J-00978, J-02918, J-07643, J-16122, J-23511, L-10503, L-12031, M-25193, N-13513, N-13591, N-18206
NUCLEAR POWER SOURCES A-16239, A-17052, A-17483, A-20736, A-20863, A-23954, A-25256, L-12031
NUCLEAR REACTIONS A-17052, B-04506
NUCLEATION A-16788, D-06755
NYLON B-09788, I-07553

O

OATS B-08938
OCCUPATIONAL HEALTH A-17052, A-22875, C-11842, D-06755, G-01340, G-04136, G-07039, G-08232, G-14530
OCEANS A-10754, C-16875, E-21986
OCR PROCESSES A-16949, B-08917, B-10281, B-13813, L-01590, L-13049
ODORS A-02765, A-24500, B-00975, B-06636, C-16860, D-00858, D-03431, D-03514, D-05010, D-09591, G-11828, L-00311, L-00973, L-01890, L-03452, L-08062
OHIO A-01489, A-13848, B-01796, B-01866, B-02909, B-06636, C-07516, C-18012, L-00973, L-08062, L-09443, L-11185, L-11781, L-25688, N-04432
OIL BURNERS A-09482, A-10743, A-23044, B-03045, B-09191, B-09833, B-10993, B-17250, B-21643
OIL RESOURCES A-07759, A-08388, A-08390, A-08391, A-08393, A-09737, A-09989, A-11739, A-13954, A-13963, A-16239, A-18276, B-05454, B-22559, L-11185, N-04432, N-13429
OKLAHOMA A-01489, C-07516, L-08062, M-01221
OLEFINS A-10424, A-16877, B-06636, B-19373, C-11842, F-22319, H-00316, H-02299, H-05420
OPEN BURNING A-00972, A-09686, A-09737, A-10740, A-10743, A-10754, A-25549, B-01799, B-02772, B-19602, C-16875, C-18012, D-00858, D-03431, D-05010, D-09591, H-01398, L-00206, L-01265, L-01890, L-03359, L-25688, M-00336, M-08072, N-00164
OPEN HEARTH FURNACES A-00972, A-03587, A-09686, A-09737, B-00107, B-03232, B-07673, B-10680, B-20073, D-00657, F-13620, J-01546, L-00311
OPERATING CRITERIA A-04778, A-16410, B-02398, B-04791, B-13829, B-14269, B-14322, F-01379, F-01380, N-05194
OPERATING VARIABLES A-09831, A-14794, A-16489, A-16492, A-17910, A-24508, A-24732, A-26226, A-26233, B-05310, B-05857, B-09833, B-12308, B-12424, B-16250, B-16279, B-16425, B-17343, B-19471, B-19581, B-19724, B-20035, B-20097, B-20437, B-20526, B-20738, B-21005, B-21324, B-21643, B-21893, B-22110, B-22291, B-22501, B-22868, B-22869, B-23140, B-23331, B-23447, B-23674, B-23955, B-24458, B-24480, B-24630, B-24675, B-24837, B-25164, B-25207, B-25416, B-25503, B-25663, B-25833, B-26143, B-26220, B-26237, C-22391, C-22885, C-23121, E-19737, E-21099, I-03222
OPINION SURVEYS D-03432
OREGON C-07516, L-08062, M-01220
ORGANIC ACIDS A-00972, A-05011, A-05067, A-09686, A-22875, B-00975, B-26084, B-26211, C-03592, F-10429
ORGANIC NITROGEN COMPOUNDS B-03337, B-03581, B-08352, B-12503, B-16500, B-24048
ORGANIC PHOSPHORUS COMPOUNDS B-00975, L-24214
ORGANIC SULFUR COMPOUNDS A-12202, A-13978, B-00975, B-05454, B-15692, B-15693, B-20550, B-25560, B-26211, D-09591, H-05420, J-01660
ORGANIC WASTES B-01799
ORGANOMETALLICS A-09831, B-03974, B-07962, L-24214
ORLON B-09788
ORSAT ANALYSIS A-05067, C-00886, C-16860
OUTPATIENT VISITS G-08230
OVERFIRE AIR A-00532, B-03053, B-05162, B-08085, B-16068, B-18290, B-24480, F-01852
OWENS JET DUST COUNTERS D-06755
OXIDANT PRECURSORS B-00975
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OXIDATION A-10754, A-12619, A-16788, B-00135, B-00140, B-00222, B-00564, B-01245, B-01727, B-01799, B-02442, B-02970, B-03581, B-08429, B-09666, B-09833, B-10591, B-10680, B-10692, B-11252, B-11906, B-11910, B-15693, B-19378, B-20539, B-22001, B-22012, B-22279, B-22961, B-23773, B-24643, B-25088, C-02921, C-11842, E-00023, E-11624, E-25212, F-10422, F-16883, I-04622, J-01707, K-00167, N-07845
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L-00973, L-01265, L-01654, L-01890, L-02011, L-02052, L-02831, L-02960, L-03277, L-03359, L-03452, L-05499, L-06188, L-06615, L-06730, L-06737, L-07550, L-07794, L-07950, L-08062, L-09443, L-09445, L-09474, L-10166, L-17472, L-17473, L-18220, L-19062, L-20698, L-24033, L-24214, L-25688, M-01567, M-08072, M-25188, M-25193, N-00164, N-02632, N-04212, N-04432, N-06133, N-07431, N-07845, N-21287, N-21289, N-21360, N-23125

PEAT A-13785, A-18171, A-25259, B-00135, B-02974, B-08371, L-10166, L-20698

PENELEC (CONTACT PROCESS) B-00135, B-01362, B-01726, B-01727, B-02195, B-04506, B-04655, B-06136, B-08346, B-08836, B-09999, B-10692, B-10968, B-12091, B-12645, B-15031, B-16862, B-16872, B-20550, B-23315, B-24707, J-01659, L-01590, L-08686

PENNSYLVANIA A-01489, A-16855, A-17418, A-23239, B-00276, B-01727, B-01866, B-02772, B-06636, B-08870, B-13835, C-07516, C-23350, D-03432, D-23957, E-07428, F-00530, F-07059, G-16837, G-18109, J-01707, L-00973, L-01590, L-03277, L-05105, L-06188, L-07550, L-09443, L-11185, L-11266, L-11781, L-18121, N-04212

PERMEABILITY B-22871, C-25872

PERMITS H-11733, L-01265

PEROXIDES B-15693, C-11842, C-25147

PEROXYACETYL NITRATE G-20700, G-21276, H-02299, H-05420

PEROXYACYL NITRATES A-16722, B-06636, G-20700, G-21276, H-00316, H-02299, H-05420

PERSONNEL B-00975, B-08080, B-18290, L-01265, L-01890, L-09073, N-01063

PERYLENES A-05011, A-05067, A-10424, A-16877, C-00945, F-10429

PESTICIDES C-09624, F-00530, H-05420, L-02831

PETER SPENCE PROCESS (CLAUS) B-01362, B-08836, B-11910, B-21005, B-23315, L-01590, L-11283, L-24033

PETROLEUM DISTRIBUTION A-08393, A-10442, A-13785, B-25427, N-00164

PETROLEUM PRODUCTION A-00972, A-09737, A-10442, A-13785, A-17199, A-17398, B-00107, B-08429, B-10680, B-10968, B-15962, B-19733, B-22809, B-25047, C-17468, C-21663, D-12496, J-16174, J-26193, K-00167, L-06730, M-00336

PETROLEUM REFINING A-07759, A-07963, A-08393, A-09686, A-09737, A-15517, A-17199, A-25213, B-00107, B-00975, B-08342, B-09195, B-09789, B-09833, B-11910, B-16851, B-19733, B-21594, B-21819, B-23447, B-24673, C-04889, C-17468, C-21663, D-09591, G-01865, G-11828, H-06967, I-07553, I-20820, J-00166, J-01546, J-21241, L-08686, L-10998, L-11242, L-11266, L-11526, M-00336

PETUNIAS H-05420

PH B-07430, B-08080, B-08938, B-18063, B-21720, B-23221, B-23504, B-23773, C-25147, E-00023, E-10153, G-06826, G-20700, G-23151, H-20982

PHENANTHRENES A-13494, A-16877, C-00945

PHENOLS E-07580, G-07138

PHILADELPHIA L-05105, L-06188, L-07550, L-09443, L-11266, L-18121

PHOSPHATES B-12672, B-24142, J-08867, L-11242

PHOSPHORIC ACID A-09686, B-02442, B-09789, B-24142, B-25038, B-25743

PHOSPHORUS COMPOUNDS A-00972, A-06351, B-06490, B-08347, B-12672, B-24142, C-13477, J-08867, L-11242, N-07431

PHOTOCHEMICAL REACTIONS A-16788, A-25213, B-03337, B-06636, B-21234, C-24412, E-11624, G-21276, H-02299, H-05420, H-07786, L-00206, M-25188

PHOTOELECTRIC PHENOMENA B-07359

PHOTOGRAPHIC METHODS C-01857, E-06373, E-07801, E-10053, E-10421, E-19503, E-24509, F-10429

PHOTOLYSIS E-11624

PHOTOMETRIC METHODS A-07570, B-06999, B-07359, C-03546, C-04759, C-07721, C-21663, D-06777, D-23356, E-16803, L-17472

PHOTOOXIDATION B-06636, E-11624

PHOTOSYNTHESIS F-00530, H-20982

PHYSICAL STATES A-03113, A-03587, A-07570, A-08390, A-09165, A-10424, A-10442, A-10740, A-16410, A-16887, A-18052, A-19994, A-22159, A-24817, A-24916, A-25062, A-25867, B-00653, B-00975, B-01485, B-01493, B-02407, B-02424, B-02970, B-02971, B-02974, B-03045, B-03337, B-03879, B-03974, B-04179, B-04634, B-04755, B-04791, B-05162, B-05338, B-07075, B-07673, B-07931, B-08352, B-08574, B-08584, B-08825, B-08919, B-08936, B-08939, B-08940, B-09191, B-09833, B-09904, B-09971, B-10003, B-10165, B-10680, B-10933, B-11131, B-11238, B-12503, B-12672, B-14194, B-15532, B-15560, B-15902, B-15962, B-16496, B-17531, B-19373, B-19876, B-20779, B-22615, B-22702, B-22871, B-23027, B-23376, B-23447, B-23526, B-24001, B-24643, B-24756, B-24785, B-25079, B-25139, B-25186, B-25320, B-26220, C-03592, C-09624, C-22391, C-23121, E-10153, E-11370, E-13965, E-24109, E-24439, E-24569, F-00105, F-01852, F-04939, F-08943, F-10422, F-10429, F-11163, F-11722, F-13766, F-14390, F-14512, F-14851, F-16376, F-22319, G-02417, H-02299, I-04622, I-07553, K-00167

PHYTOTOXICANTS F-00530, H-00316, H-02299, H-05420, L-00162

PILOT PLANTS A-08390, A-16949, B-01187, B-02407, B-02727, B-04508, B-05508, B-06543, B-06636, B-07075, B-08347, B-08870, B-09163, B-10591, B-11055, B-12234, B-12424, B-12442, B-12797, B-13663, B-14261, B-14322, B-14730, B-15031, B-16173, B-17338, B-17905, B-20392, B-21381, B-21720, B-22110, B-22160, B-22868, B-22869, B-23221, B-23544, B-23718, B-25071, B-25663, E-21099, F-01852, J-01679, J-08867, L-06737

PINTO BEANS H-02299, H-05420

PITTSBURGH A-17418, B-01727, B-08870, B-13835, J-01707, N-04212

PLAINS B-22884

PLANNING AND ZONING A-16073, A-21221, A-25975, B-24826, D-03431, L-00973, L-01399, L-01890, L-10166, L-18220, L-25688, L-26157, M-25193, N-17819

PLANS AND PROGRAMS A-01480, A-02501, A-02765, A-03587, A-04333, A-07963, A-09737, A-10743, A-11619, A-12619, A-13292, A-13316, A-16073, A-17398, A-18078, A-19434, A-21191, A-22800, A-25196, A-26299, B-00975, B-01796, B-02192, B-06345, B-14159, B-14270, B-16731, B-23708, B-25187, C-23350, C-24245, C-25147, D-00657, D-00858, D-01790, D-02818, D-03431, D-03432, D-03514, D-05010, D-06755, D-06777, D-07393, D-07951, D-09591, D-09984, D-11525, D-12496, E-07428, E-08400, E-10153, E-10368, E-25815, G-01865, G-02417, G-07039, G-08230, G-18109, H-01589, H-06967, J-00253, J-01546, J-01679, J-11111, L-00206, L-01265, L-01585, L-01590, L-01890,

L-02052, L-02960, L-03277, L-03359, L-03452, L-05105, L-05499, L-06188, L-06615, L-07550, L-07950, L-08062, L-08686, L-09073, L-09443, L-09445, L-09474, L-11319, L-11526, L-12461, L-14535, L-17321, L-24214, L-25688, L-26157, M-00336, M-01567, N-00164, N-03344, N-05194, N-14816, N-18206
PLANT DAMAGE A-01842, A-02765, A-21383, B-00140, B-00975, D-03432, D-06755, F-00530, G-08232, H-00316, H-01014, H-01398, H-01589, H-02299, H-05420, H-06967, I-20820, J-00166, L-00162, L-02960, L-03452, L-11266, L-24033, N-04212
PLANT GROWTH A-12335, E-15178, F-00530, H-01014, H-02299, H-19620, H-20982
PLANT INDICATORS B-04655
PLANTS (BOTANY) A-10754, A-18171, B-00140, B-00975, B-06999, B-08938, B-09788, F-00530, G-08232, H-00316, H-01014, H-01398, H-01589, H-02293, H-02299, H-05420, H-06967, H-07786, H-20982, J-00166, L-00311, L-03359, N-00164, N-04212
PLASTICS B-07515, B-08825, B-09788, B-25088, B-26084, D-00657
PLATINUM B-03337, B-03581, B-21232
PLUME BEHAVIOR A-00532, A-00691, A-01350, A-01842, A-10284, A-12335, A-13102, A-15701, A-16788, A-16887, A-17051, A-22159, B-00687, B-00975, B-01796, B-02311, B-04200, B-07466, B-09699, B-10770, B-11262, B-12581, B-13057, B-14159, B-15358, B-15572, B-15616, B-16815, B-19029, B-22051, B-22884, B-23237, B-24001, B-25298, C-01856, C-03546, C-04040, C-09624, C-11340, C-15925, C-18012, C-23377, D-02046, D-02979, D-06777, D-08858, D-11525, D-16237, D-23957, E-00023, E-00846, E-01259, E-01260, E-01261, E-01934, E-03251, E-03557, E-04033, E-04034, E-04035, E-05357, E-05702, E-06373, E-06775, E-06823, E-07801, E-09417, E-10053, E-10219, E-10220, E-10421, E-10608, E-10751, E-11514, E-11624, E-11980, E-12353, E-14271, E-15483, E-15511, E-16285, E-16687, E-16863, E-16985, E-17580, E-17595, E-17734, E-19503, E-19737, E-20163, E-20523, E-21073, E-21099, E-21122, E-21736, E-22313, E-23409, E-24243, E-24341, E-24407, E-24486, E-24509, E-25229, E-25935, E-26267, F-00530, G-00981, H-07786, L-02960, L-03277, L-08686, L-11526, L-12461
PLUTONIUM COMPOUNDS A-10442, A-23170, J-07643
PNEUMOCONIOSIS A-22875, B-10165, D-06755, G-01340, G-04136, G-07039, G-11437, G-14530
PNEUMONIA D-22591, E-25075, G-16837, G-20700, G-23670
POINT SOURCES D-09591, D-11525, E-02410, E-04033, E-04034, E-10219, E-10220, E-10368, E-10751, E-11065, E-11514, E-16629, E-19737, E-21073, E-22313, E-24407, E-25229, L-11266, L-25688
POLAROGRAPHIC METHODS A-13494, A-21999
POLLENS D-05010, D-06755
POLLUTION PRECURSORS B-00975, D-05551
POLYNUCLEAR COMPOUNDS A-00532, A-00972, A-02549, A-03113, A-05011, A-05067, A-07570, A-10424, A-10754, A-13494, A-16877, A-17017, A-23884, A-25545, A-25549, B-01362, B-04200, B-12040, C-00945, C-03592, D-00858, D-07393, F-10429, N-04212, N-21289
PORTABLE C-01354, C-04889, C-16860, C-22885, E-25815
POTASSIUM COMPOUNDS A-09165, A-23359, B-08942, B-09600, B-11191, B-12672, B-14838, B-15692, B-22327, B-22756, B-23376, C-23096, F-04827, F-08943, F-11163, I-04622, N-04432, N-07431
POTATOES B-08938, H-05420
POTENTIOMETRIC METHODS B-24837
POWER CYCLES A-01842, A-03340, A-04652, A-07644, A-12541, A-18056, B-00687, B-01485, B-01493, B-02053, B-02192, B-02727, B-02971, B-04200, C-00403, C-01856, C-02655, D-06777, E-00023, E-06373, G-00981, G-02417, J-01660, J-02151, K-06778, L-01654, L-03359, L-09443, M-01220, M-01221, N-00164, N-03344
POWER SOURCES A-01842, A-02290, A-03867, A-04287, A-04652, A-04778, A-07644, A-07793, A-08392, A-08393, A-09169, A-09353, A-09686, A-10183, A-10424, A-10754, A-12541, A-14980, A-16239, A-16722, A-17052, A-17483, A-17910, A-18052, A-19038, A-20736, A-20863, A-21204, A-23954, A-25256, A-25259, A-25418, A-25549, B-02424, B-02442, B-04506, B-06636, B-08080, B-08584, B-08713, B-08870, B-09905, B-09996, B-10493, B-10680, B-10770, B-14394, B-15544, B-18167, B-19261, B-20779, B-21819, B-24954, B-25139, B-25529, B-26237, C-00886, C-22882, D-00858, D-07393, D-09591, D-12496, F-11257, F-14686, G-11828, J-00166, L-02011, L-03359, L-05499, L-06686, L-09073, L-12031, M-25143, N-00164, N-01063, N-05194, N-17819, N-21289
PRECIPITATION A-10754, B-02407, B-24001, D-05010, D-09591, E-02410, E-05702, E-08400, E-10153, E-10608, E-23723, E-25212, F-01379, G-20700, H-02293, L-02011, N-04212
PRESSURE A-09165, B-01615, B-03879, B-04634, B-04655, B-05162, B-05163, B-05338, B-05531, B-07075, B-07430, B-07673, B-07674, B-08346, B-08347, B-08371, B-08908, B-09833, B-10003, B-10993, B-15532, B-17338, B-19803, B-20485, B-21720, B-22110, B-23374, B-23526, B-25088, B-25677, C-02655, C-16512, F-04939, F-13766, F-22587
PRESSURE (ATMOSPHERIC) B-00687, B-11131, E-02410, E-05702, E-23723, E-24109, F-01379, F-04939
PRIMARY METALLURGICAL PROCESSING A-03587, A-07963, A-08392, A-09686, A-09737, A-13261, A-14400, A-14701, A-15517, A-17199, A-17357, A-17398, A-17464, A-17688, A-19434, A-21221, A-21999, A-22867, A-24039, A-25196, A-25213, A-25549, B-00107, B-00222, B-00975, B-02036, B-03232, B-03337, B-07931, B-08342, B-08429, B-09788, B-09789, B-09833, B-10591, B-10968, B-12503, B-14270, B-15844, B-15962, B-16500, B-16681, B-16851, B-19733, B-20188, B-21324, B-22615, B-22702, B-22809, B-23955, B-24048, B-24673, B-24756, B-24881, B-25019, B-25047, B-25139, B-25743, B-26063, C-16875, C-21663, D-00657, D-09591, D-12496, D-22812, D-23326, E-23409, G-08232, G-16192, G-16837, H-01398, H-06967, H-19620, I-07553, I-20820, J-16174, J-26193, K-02010, K-06778, L-00973, L-01890, L-06730, L-07950, L-08062, L-09443, L-10998, L-11242, L-11526, L-19062, L-24033, L-24214, N-21287
PRINTING D-03431, J-26193
PROCESS MODIFICATION A-00532, A-02633, A-02634, A-03072, A-04778, A-04937, A-05011, A-05067, A-09103, A-10442, A-10743, A-11968, A-12619, A-16410, A-19038, A-23359, A-23884, A-24817, A-26226, B-02398, B-03053, B-03974, B-04200, B-04516, B-04634, B-05162, B-05163, B-05258, B-05857, B-07962, B-08085, B-08346, B-08378, B-08429, B-08825, B-08870, B-08908, B-09163, B-09833, B-10399, B-10770, B-10993, B-11191, B-11906, B-12040, B-12308, B-12443, B-12446, B-13394, B-13813, B-15560, B-16068, B-16502, B-16681, B-17250, B-17392, B-17782, B-18167, B-18290, B-18296, B-19034, B-19471, B-20063, B-20073, B-20082, B-20425, B-20854, B-21234, B-21381, B-21643, B-22671, B-22861, B-23880, B-24073, B-24480, B-24642, B-24678, B-24681, B-24697, B-24922, B-25139, B-25186, B-25269, B-25284, B-25494, B-25517, B-26237, D-11525, E-11065, F-01852, F-04939, F-09064, F-16376, J-11114, L-01265, L-20698
PROPANES B-05857, B-08352, F-22319
PROPELLER AIRCRAFT C-15479, C-18012, E-11065, N-00164
PROPENES C-11842
PROPOSALS A-01842, A-16073, A-24915, B-04506, B-05529, B-22861, D-05010, J-11111, L-03452, L-07950, L-25688
PUBLIC AFFAIRS B-00975, B-07416, D-03431, D-03432, D-05428, J-08059, L-00311, L-03277, L-03452, L-09073, M-00336, M-08072, M-22636, N-04212
PUBLIC INFORMATION L-00311, L-03277, M-22636, N-04212
PULMONARY FUNCTION F-00530, G-18109, I-20820
PULMONARY RESISTANCE G-18109, I-20820
PULVERIZED FUELS A-02633, A-02634, A-04937, A-05011, A-05067, A-05169, A-16410, A-16788, A-18114, B-00653, B-01866, B-02407, B-03879, B-04940, B-05258, B-05454, B-05853, B-07752, B-08863, B-08870, B-09195, B-09923, B-10681, B-11215, B-12574, B-13856, B-18111, B-19339, B-19724, B-22961, B-23682, B-24675, B-25269, B-25786, C-01857, C-09107, C-16734, C-22909, E-16803, E-21099, F-01852, F-04939, F-09064, F-11135, F-15714, F-16883
PYRENES A-00972, A-02549, A-05011, A-05067, A-07570, A-10424, A-10754, A-16877, A-23884, A-25545, A-25549, C-00945, D-00858, D-07393, N-04212, N-21289
PYROLYSIS A-08391, A-16877, A-19444, B-03337, B-08228, B-25184, B-26084, F-10422, F-10429, F-11782, F-14851, F-22319, F-22587

Q

QUARTZ B-08825, B-09788, B-10165, C-08123, G-11300
QUESTIONNAIRES A-02634, A-12619, G-16837, H-06967, L-09474

R

RABBITS I-20820
RADIATION COUNTERS A-02860
RADIATION MEASURING SYSTEMS A-02860, E-26141
RADIOACTIVE RADIATION A-02631, A-02860, A-06978, A-10442, A-13494, A-16855, A-16877, A-16887, A-17052, A-17483, A-17542, A-18078, A-19318, A-19994, A-21191, A-21286, A-21351, A-21383, A-21916, A-23170, A-23652, A-25914, A-25975, B-11262, B-26220, C-01363, C-07941, C-19519, C-22511, E-05702, E-10608, E-21073, E-24391, E-24569, E-25935, E-26141, H-05420, M-25193
RADIOACTIVE TRACERS A-16877, A-21383, E-21073, E-26141, H-05420
RADIOGRAPHY G-07039, G-07138, G-14530
RADIOLOGICAL HEALTH A-21916
RADIOSONDES E-10421, E-11065
RADON A-16855, A-19318
RAGWEED D-05010, L-03452
RAIN D-05010, E-05702, E-08400, E-10153, E-25212, G-20700, H-02293, N-04212
RAPPING B-04940, B-05508, B-07385, B-07931, B-09789, B-23305, B-25127
RATS G-11300
REACTION KINETICS A-16788, A-19444, A-25108, A-26226, B-00544, B-04842, B-07466, B-09833, B-09971, B-11055, B-12581, B-15284, B-16346, B-19581, B-21005, B-22756, B-23374, B-23526, B-23544, B-24269, B-24678, B-26084, E-21099, F-09064, F-09967, F-10429, F-14851, F-16883, F-22319, F-22587
REACTION MECHANISMS A-13494, A-16788, A-23170, A-26226, B-06636, B-09833, B-12503, B-12581, B-20539, B-23374, B-23526, B-26155, C-22391, E-21099, E-23409, F-08943, F-16376, F-16883, F-22587, I-11286
REACTORS (NUCLEAR) A-07644, A-08388, A-10442, A-12088, A-16887, A-17052, A-17483, A-18078, A-18276, A-21916, A-23170, A-25256, A-25914, A-25975, B-04755, B-08917, B-21381, B-26220, C-01363, C-11755, C-16364, C-25231, D-25476, E-05702, E-10608, E-14271, E-21073, E-24391, E-24407, E-24509, E-24569, E-25935, F-11257, F-13400, J-07643, L-10503, N-13513, N-18206
RECORDING METHODS A-01510, C-01857, D-08858, E-00023, E-06373, E-07801, E-10053, E-10421, E-19503, E-24391, E-24509, F-10429
REDUCTION A-12619, A-19017, A-26226, B-00135, B-03337, B-03581, B-06543, B-09666, B-10336, B-12234, B-16500, B-19378, B-19380, B-19475, B-19541, B-19560, B-19672, B-19678, B-19874, B-20914, B-22012, B-22014, B-22279, B-22327, B-22702, B-22740, B-22869, B-22905, B-23374, B-23526, B-23880, B-24048, B-24253, B-24270, B-24397, B-24516, B-24554, B-24565, B-24673, B-24678, B-24777, B-25320, B-25323, B-25430, B-25787, B-25795, B-25973, B-26155, F-10422
REFRACTORIES B-09833, B-24480, B-25207, F-00105, L-08062
REGIONAL GOVERNMENTS A-16073, A-24535, L-03359, L-08062, L-09073, L-09443
REGULATIONS A-05530, A-06040, A-07642, A-14574, A-19434, A-25975, B-00107, B-00975, B-02032, B-02772, B-04516, B-06345, B-08348, B-10493, B-16815, B-19471, B-22559, J-00253, J-07643, J-08059, J-16506, J-19685, K-06778, L-00311, L-00973, L-01585, L-01654, L-01890, L-03359, L-07550, L-07794, L-09443, L-09474, L-11185, L-11266, L-11383, L-11781, L-17473, L-18220, L-20698, L-25688, N-21287
REINLUFT PROCESS (ADSORPTION) B-00135, B-00140, B-01362, B-01726, B-01727, B-02053, B-02195, B-02778, B-02971, B-04200, B-04506, B-04655, B-05454, B-06136, B-06345, B-08342, B-08346, B-08836, B-09666, B-09833, B-09999, B-10968, B-12091, B-12253, B-13501, B-13829, B-14660, B-15436, B-16418, B-16851, B-16872, B-19471, B-20550, B-21028, B-21504, B-22110, B-23315, B-23373, B-24707, B-24756, B-24837, B-25584, J-01707, J-08867, L-08686, L-11283, L-14535
RENDERING L-06730, L-08062
RESEARCH INSTITUTES A-06040, A-26299, B-11910, E-10368, G-01340, L-08686, M-08072
RESEARCH METHODOLOGIES A-08392, A-26085, B-09971, D-00858, D-09984, E-06775, E-09417, F-00530, F-04827, F-09769
RESEARCH PROGRAMS A-06040, A-08391, A-16949, A-18078, A-22800, B-04507, B-06345, B-06636, B-07075, B-08347, B-08863, B-08917, B-09996, B-11178, B-11910, B-13051, B-13057, B-13813, B-14546, B-14707, B-15544, B-18110, B-20563, B-21381, B-21819, B-22861, B-23176, B-23237, B-23880, B-24142, B-24826, B-25038, B-25165, G-01340, G-01865, G-07039, G-11300, H-01589, L-01590, L-03277, L-06686, L-08686, L-09443, L-11319, L-11526, L-14535, L-19062, M-08072, M-22636, N-07845
RESIDENTIAL AREAS A-07647, A-08393, D-02057, D-07141, D-07393, D-09591, D-11525, D-13176, D-23326, E-06775, E-17725, G-07138, L-01399, L-07550, L-09474, M-00336, N-21289
RESIDUAL OILS A-00943, A-01480, A-07759, A-09737, A-09831, A-14378, A-15620, A-20736, A-22867, A-23753, A-25690, B-00205, B-01493, B-03974, B-07515, B-07962, B-08080, B-08346, B-08347, B-08429, B-08713, B-08836, B-08908, B-08917, B-09191, B-09666, B-09833, B-09999, B-10680, B-10968, B-14394, B-15240, B-20082, B-20729, B-23315, B-23708, B-24207, B-25187, B-25677, C-16860, D-09591, E-06775, E-21099, G-01865, H-11733, J-00166, J-08059, J-11114, J-13613, K-00167, L-01590, L-05105, L-07550, L-08686, L-11185, L-11266, M-01220, M-01221
RESPIRATORY DISEASES A-11988, A-17357, A-17688, A-22875, B-10165, D-02818, D-03432, D-05260, D-06755, D-22591, E-25075, F-00530, G-00981, G-01340, G-01865, G-04136, G-07039, G-07138, G-08230, G-08232, G-11300, G-11339, G-11437, G-12289, G-14530, G-16837, G-18109, G-20700, G-21276, G-23151, G-23670, G-24021, J-00166, L-03359, L-11266, N-21360
RESPIRATORY FUNCTIONS A-16855, A-24005, B-07416, B-10704, B-12672, B-12797, C-11340, D-25476, E-05702, E-10608, E-21986, E-24569, F-00530, G-06806, G-08232, G-18109, I-20820, N-21287
RESPIRATORY SYSTEM A-16855, A-17357, B-22792, C-01857, F-00530, G-01865, G-04136, G-06806, G-07138, G-08230, G-08232, G-11437, G-18109, G-20700, I-20820
RETENTION A-22387, D-06755, G-06806
RHODE ISLAND L-08062
RINGELMANN CHART A-00532, B-00975, B-08713, B-09833, B-10770, B-13394, B-18290, C-01857, C-03546, C-07721, C-16860, L-00206, L-00311, L-00973, L-18220
RIVERS A-07645, D-03514, E-10153, G-02417, L-24214
RUBBER A-10424, B-24697, I-07553, L-08062
RUBBER MANUFACTURING J-21241, L-06730

S

SAFETY EQUIPMENT A-05530, A-25690, B-04179, B-08352
SALARIES A-07647
SALTZMAN METHOD D-22812, E-11624
SAMPLERS A-05067, A-19994, B-00135, B-00975, B-01796, B-04200, B-08921, B-22615, C-00886, C-00945, C-01354, C-01856, C-03460, C-04040, C-07787, C-11193, C-16860, C-18012, C-21663, C-23096, C-23121, C-24412, C-26139, D-02818, D-03514, D-06755, D-07951, D-08298, D-08858, D-09591, D-22812, E-11624, G-21276, K-09921, L-01890, L-03277, L-09445, N-04212
SAMPLING METHODS A-02549, A-03113, A-05011, A-05067, A-09161, A-19994, A-21916, A-22875, B-00135, B-00975, B-01712, B-01796, B-01866, B-04200, B-07075, B-07359, B-08378, B-08863, B-08921, B-10003, B-13857, B-16240, B-18296, B-19642, B-21594, B-22401, B-22615, B-23757, C-00403, C-00886, C-00945, C-01354, C-01363, C-01856, C-02655, C-02921, C-03460, C-03592, C-04040, C-06095, C-07721, C-07787, C-07848, C-08123, C-09107, C-11193, C-12510, C-13477, C-15479, C-16512, C-16734, C-16860, C-16875, C-17419, C-17474, C-18012, C-21663, C-22342, C-22391, C-22882, C-22909, C-23096, C-23121, C-24245, C-24412, C-26139, D-02818, D-03514, D-05551, D-06755, D-06819, D-07951, D-08298, D-08858, D-09591, D-22812, E-00023, E-04033, E-04034, E-06823, E-10010, E-11624, E-21099, F-15714, F-16883, G-07039, G-21276, K-09921, K-21896, L-00311, L-01890, L-03277, L-03452, L-09445, L-09474, N-04212, N-13587

SAMPLING PROBES A-05011, A-09161, B-22401, C-02655, C-04040, C-07787, C-16512, C-16734, C-22882, C-22909, D-08858, F-15714, F-16883, K-09921, N-13587

SAN FRANCISCO L-00973, L-06188, L-11266

SCATTERING (ATMOSPHERIC) E-16687, E-16803, E-17612, E-21736

SCREEN FILTERS B-08155, B-18161, B-20188, B-20738

SCRUBBERS A-00972, A-03587, A-04937, A-09686, A-12619, A-13141, A-13410, A-15391, A-15620, A-23044, A-23379, A-24916, A-24978, A-25062, A-26226, A-26233, B-00107, B-00135, B-00140, B-00975, B-01362, B-01493, B-02407, B-02971, B-03045, B-03337, B-03879, B-04634, B-04791, B-05163, B-05198, B-05531, B-06999, B-07385, B-07416, B-07430, B-07466, B-07752, B-07931, B-08146, B-08155, B-08342, B-08346, B-08378, B-08429, B-08836, B-09523, B-09607, B-09666, B-09833, B-09999, B-10264, B-10493, B-11159, B-11252, B-12040, B-12234, B-12503, B-12581, B-13767, B-13856, B-14137, B-14162, B-14207, B-14270, B-14322, B-14632, B-14707, B-15436, B-15489, B-15572, B-15665, B-15902, B-16248, B-16250, B-16282, B-16500, B-16681, B-16720, B-16731, B-16872, B-17004, B-17124, B-17531, B-17905, B-17979, B-18110, B-18154, B-18161, B-18290, B-19380, B-19394, B-19471, B-19608, B-19803, B-19845, B-20035, B-20097, B-20141, B-20392, B-20696, B-20854, B-20914, B-21136, B-21200, B-21238, B-21268, B-21720, B-22070, B-22160, B-22291, B-22327, B-22401, B-22756, B-22868, B-22869, B-22871, B-23027, B-23140, B-23146, B-23221, B-23231, B-23315, B-23374, B-23376, B-23504, B-23682, B-23708, B-23773, B-23822, B-23879, B-23880, B-23955, B-24048, B-24168, B-24181, B-24441, B-24613, B-24673, B-24678, B-24697, B-24707, B-24756, B-24837, B-24881, B-24985, B-25019, B-25165, B-25320, B-25416, B-25517, B-25584, B-25602, B-25663, B-25743, B-26063, B-26211, B-26237, C-21663, D-05260, E-16985, F-00530, F-13487, G-24021, H-06967, J-01546, J-01707, J-16122, J-16129, J-21241, J-26193, L-08062, L-11526, L-19062, L-24033, M-25193, N-21360

SEA BREEZE E-23723

SEASONAL A-01510, A-10424, A-11411, A-11619, A-14997, A-24500, B-11250, D-00657, D-03431, D-03514, D-04116, D-05428, D-06824, D-07141, D-07393, D-08858, D-09591, D-10723, D-11525, E-01259, E-02410, E-10220, E-10368, E-11514, E-23723, G-08232, G-21276, L-01890, L-25688, M-00336

SECONDARY AIR A-09103, B-03053, B-08908, B-09833, B-19471

SEDIMENTATION A-09686, A-11982, B-05163, B-07385, B-08155, B-19602, B-19834, B-24609, B-25517, B-25584, E-24569, F-00530

SELENIUM COMPOUNDS B-24441

SENATE HEARINGS A-24732, B-08917, G-24021

SETTLING CHAMBERS A-03587, A-26233, B-05163, B-07385, B-08155, B-16720, B-25517, B-25584, C-21663, D-01790

SETTLING PARTICLES A-00532, A-01350, A-02014, A-02549, A-02633, A-03587, A-04937, A-05506, A-07570, A-09161, A-09353, A-09831, A-10424, A-10442, A-10678, A-11982, A-12541, A-13261, A-13330, A-13410, A-13832, A-14794, A-15246, A-16410, A-16788, A-17017, A-19017, A-19084, A-19434, A-21916, A-22875, A-24005, A-24500, A-24535, A-24817, A-24915, A-25062, A-25213, A-25545, A-25549, B-00107, B-00140, B-00272, B-00975, B-01485, B-01615, B-01712, B-01796, B-02032, B-02036, B-02149, B-02206, B-02311, B-02398, B-02909, B-02974, B-03045, B-03232, B-04179, B-04200, B-04508, B-04634, B-04655, B-04940, B-05163, B-05198, B-05310, B-06062, B-06307, B-06490, B-06835, B-07075, B-07359, B-07385, B-07416, B-07430, B-07674, B-07931, B-08080, B-08085, B-08155, B-08346, B-08348, B-08378, B-08470, B-08584, B-08825, B-08836, B-09469, B-09496, B-09546, B-09788, B-09789, B-09833, B-09923, B-10165, B-10681, B-10933, B-11055, B-11906, B-11910, B-12442, B-12581, B-13015, B-13057, B-13857, B-14194, B-14223, B-14270, B-14294, B-14473, B-14707, B-15155, B-16068, B-16720, B-17318, B-17392, B-17672, B-17905, B-17979, B-18161, B-18296, B-19029, B-19346, B-19378, B-19724, B-19803, B-19845, B-19972, B-20097, B-20188, B-20223, B-20243, B-21117, B-21313, B-21886, B-22070, B-22160, B-22401, B-22501, B-22505, B-22560, B-22671, B-22792, B-23176, B-23220, B-23237, B-23262, B-23305, B-23674, B-23955, B-24480, B-24642, B-24643, B-24697, B-24756, B-25079, B-25127, B-25164, B-25186, B-25207, B-25217, B-25269, B-25323, B-25584, B-25663, B-25744, B-25973, B-26063, B-26143, C-01857, C-02655, C-04759, C-07721, C-07787, C-07848, C-08123, C-09107, C-09624, C-16512, C-17468, C-17474, C-19519, C-22342, C-22882, C-23121, C-24412, C-25260, C-25872, D-02979, D-03431, D-03514, D-05260, D-05428, D-06755, D-06819, D-07141, D-07393, D-09591, D-10723, D-22591, D-23326, E-06775, E-07580, E-16985, E-24569, F-04939, F-07059, F-11722, G-00981, G-01340, G-02417, G-04136, G-06806, G-07039, G-07138, G-08230, G-11339, G-11437, G-12289, G-14530, G-18109, G-20700, G-21276, G-23151, H-00316, H-02299, H-06967, H-07786, H-19620, H-20982, J-00166, J-01546, J-02151, J-15889, J-17203, K-02010, K-06778, K-09921, L-00206, L-00311, L-01265, L-01890, L-02011, L-02052, L-02960, L-03359, L-06188, L-06737, L-07550, L-07950, L-08062, L-09474, L-10166, L-17472, L-17473, M-08072, N-04212, N-21287, N-21289

SEWAGE A-16949, A-22875, A-25690, B-01245, B-11238, B-15933, B-20188, B-24168, B-25427, I-07553

SEWAGE TREATMENT A-16949, A-22875, B-01245, B-15933, B-20188, I-07553

SHIPS A-04287, A-07645, A-08392, B-25427, D-09591, D-12496, L-00311, N-00164

SIEVE ANALYSIS A-13848, C-25872, F-02743, F-11163

SILICATES B-08936, B-09904, F-04827, F-08943, F-11163, G-11437

SILICON COMPOUNDS A-09831, B-03337, B-03581, B-08936, B-09788, B-09904, B-10165, B-19876, B-23880, F-04827, F-08943, F-09769, F-11163, G-11437, I-04622, N-07431

SILICON DIOXIDE A-25545, B-04842, B-05531, B-05868, B-08919, B-08937, B-08939, B-08942, B-09600, B-09788, F-07059, F-08943, F-11163, G-04136, N-04432, N-07431

SILICOSIS B-10165, D-06755, G-04136

SILVER COMPOUNDS A-06351, A-09831, C-01363, C-23096

SIMULATION A-14997, A-25418, B-04755, B-06835, B-11252, B-20539, B-26220, C-20224, C-22511, E-04033, E-09417, E-11624, E-25229, G-11300, J-11111, L-12461, L-17321

SINGLE CHAMBER INCINERATORS L-06730, N-00164

SINTERING A-00972, A-03587, A-04937, A-09737, A-17464, A-19434, B-11005, B-21893, B-22871, B-24207, K-06778, L-05730

SKIN F-00530, G-07138

SKIN CANCER A-17688

SLAUGHTERHOUSES H-06967

SLUDGE A-25690, B-11238, B-24168

SMOG A-09353, A-23726, A-24039, A-25549, B-00107, B-00975, B-19034, B-21234, C-24412, D-06755, E-15347, E-20068, E-23723, E-24341, E-25075, F-00530, G-08230, G-11828, G-18109, G-21276, G-23670, H-00316, H-01398, H-07786, I-07553, I-20820, L-09445, M-01567, M-25188, N-04212, N-07845, N-23125

SMOG INDEX G-21276

SMOKE SHADE A-00532, A-13855, A-17051, B-00975, B-08713, B-09496, B-09833, B-10770, B-13394, B-18290, C-01857, C-03546, C-07721, C-16860, D-05010, L-00206, L-00311, L-00973, L-18220

SMOKEMETERS A-19084, B-07359, B-08713, C-01857, C-03546, C-07721, C-09624, C-19047

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SUPERCOOLING A-07644, E-24109

SUPERSATURATION B-10704, B-21238

SURFACE COATING OPERATIONS A-08392, A-09686, B-08352, D-00858, D-03431, N-22794

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SURFACE PROPERTIES A-13494, B-03337, B-05454, B-05868, B-09600, B-10165, B-10680, B-25127, B-25186, B-26084, E-24439, F-13766

SURFACTANTS B-07416

SURVEY METHODS C-23350, D-00858, D-03514, D-06755, G-07039, G-08230, L-01890, L-07950, M-00336

SUSPENDED PARTICULATES A-00532, A-00972, A-02014, A-02860, A-03113, A-03587, A-04937, A-05067, A-05169, A-06040, A-09161, A-09194, A-09353, A-09539, A-09686, A-09831, A-10424, A-10442, A-10743, A-11411, A-11413, A-11502, A-11619, A-11860, A-11981, A-11982, A-11988, A-12266, A-13261, A-13832, A-14478, A-14997, A-16788, A-16855, A-16949, A-17184, A-17398, A-17688, A-17910, A-19165, A-19318, A-21286, A-21351, A-22144, A-22418, A-22875, A-23359, A-23726, A-24005, A-24039, A-24535, A-24732, A-25062, A-25549, A-25689, A-25867, B-00107, B-00135, B-00140, B-00653, B-00975, B-01187, B-01245, B-01362, B-01615, B-02036, B-02192, B-02206, B-02727, B-02908, B-02909, B-02974, B-03045, B-03053, B-03879, B-04179, B-04200, B-04506, B-04508, B-04516, B-04634, B-04755, B-04791, B-04940, B-05162, B-05163, B-05310, B-05508, B-05516, B-05531, B-05853, B-05868, B-06490, B-06636, B-06697, B-06835, B-06999, B-07359, B-07385, B-07416, B-07430, B-07515, B-07752, B-08080, B-08085, B-08146, B-08155, B-08348, B-08492, B-08584, B-08713, B-08825, B-08863, B-08870, B-08919, B-08921, B-08922, B-08923, B-08925, B-08926, B-08936, B-08937, B-08938, B-08939, B-08940, B-08942, B-09191, B-09496, B-09546, B-09600, B-09607, B-09788, B-09789, B-09833, B-09904, B-10264, B-10493, B-10655, B-10681, B-10704, B-10770, B-10993, B-11005, B-11159, B-11233, B-11238, B-11253, B-11262, B-11906, B-11996, B-12310, B-12417, B-12443, B-12446, B-12574, B-12797, B-13052, B-14087, B-14137, B-14159, B-14194, B-14269, B-14270, B-14730, B-15031, B-15251, B-15543, B-15560, B-15616, B-15665, B-15902, B-16068, B-16173, B-16224, B-16248, B-16502, B-16720, B-16746, B-16862, B-17250, B-17343, B-17392, B-18034, B-18063, B-18142, B-18290, B-18296, B-19029, B-19034, B-19261, B-19471, B-19480, B-19482, B-19541, B-19642, B-19803, B-19834, B-19845, B-20082, B-20097, B-20485, B-20552, B-20738, B-20854, B-21234, B-21268, B-21313, B-21504, B-21643, B-21720, B-22070, B-22160, B-22175, B-22559, B-22560, B-22661, B-22671, B-22756, B-22869, B-22871, B-22961, B-23140, B-23220, B-23237, B-23262, B-23331, B-23822, B-23955, B-24181, B-24480, B-24630, B-24675, B-24837, B-25038, B-25079, B-25139, B-25170, B-25207, B-25517, B-25786, C-00403, C-00886, C-01856, C-01857, C-03460, C-03546, C-04040, C-04889, C-07482, C-07941, C-09624, C-11193, C-13477, C-16734, C-16860, C-18012, C-22909, C-24412, C-25260, C-26139, D-00657, D-01790, D-02057, D-02818, D-02979, D-03431, D-03432, D-03514, D-05010, D-05260, D-05551, D-06755, D-06777, D-06819, D-07141, D-07393, D-07951, D-09591, E-00023, E-05357, E-06775, E-06823, E-06827, E-07801, E-07843, E-10010, E-10219, E-11370, E-11514, E-11624, E-11980, E-12353, E-15347, E-16687, E-16803, E-16985, E-17725, E-20068, E-20163, E-21986, E-23723, E-24109, E-24341, E-24486, E-24509, E-25075, E-25815, E-26141, E-26267, F-00530, F-04939, F-08941, F-08943, F-09769, F-14390, F-15714, G-00981, G-01865, G-02417, G-06826, G-07138, G-08230, G-08232, G-11339, G-11828, G-16837, G-18109, G-21276, G-23670, H-00316, H-01398, H-06967, H-07786, I-07553, I-20820, J-01308, J-01546, J-01707, J-02151, J-06845, J-11111, J-12418, J-17203, K-00167, K-02010, K-06696, K-06778, K-22248, L-00162, L-00206, L-00311, L-00973, L-01265, L-01654, L-01890, L-02011, L-02052, L-02831, L-02960, L-03277, L-03359, L-07550, L-07794, L-07950, L-08062, L-09443, L-09445, L-09474, L-18220, L-19062, L-20698, L-24214, L-25688, M-01567, M-08072, M-25188, N-02632, N-04212, N-04432, N-06133, N-07431, N-07845, N-21289, N-21360, N-23125

SWEDEN A-00532, A-00972, A-02549, A-02860, A-03113, A-03587, A-07793, B-00135, B-00140, B-00205, B-00222, B-00564, B-00653, B-00975, B-01245, B-01485, B-01493, B-01799, B-02407, B-02424, B-02442, B-02970, B-02971, B-02974, B-03045, B-03053, B-03337, B-03581, B-03879, B-04179, B-16720, B-18296, B-19541, B-24565, B-24613, B-24707, B-25787, B-25795, C-01354, C-01856, C-02921, C-03546, C-03592, C-04040, D-01790, E-00023, E-03557, E-10153, E-10751, F-00105, F-00530, F-01379, F-01380, F-01852, G-01865, G-02417, H-02299, J-00166, J-01707, K-00167, L-00206, L-00311, L-01890, L-02831, L-03452, L-09474

SWEET PEAS H-05420

SYNERGISM B-06636, B-25079, E-23723, G-08232, G-11300

SYNTHETIC FIBERS B-07515, B-09788, B-11910, B-24290, I-07553

SYNTHETIC RUBBER I-07553

T

TAR A-07570, A-08393, B-25186, B-25269, F-10422

TAXATION J-07643, J-08059, L-03359

TECHNICAL SOCIETIES N-01063

TEFLON B-07515, B-08825, B-09788, D-00657

TELLER (CHROMATOGRAPHIC) B-00135, B-08342, B-08347, B-10968, B-16851, B-17124, L-01590

TEMPERATURE A-02631, A-02633, A-03072, A-05011, A-05067, A-07644, A-08641, A-09103, A-09165, A-17051, A-19017, A-22649, A-23359, A-23379, A-25108, A-26226, B-00653, B-01485, B-01493, B-01615, B-02206, B-02727, B-02970, B-03053, B-03974, B-04655, B-04940, B-05258, B-05338, B-05531, B-05853, B-07425, B-08085, B-08342, B-08346, B-08347, B-08371, B-08492, B-08825, B-08836, B-08863, B-08870, B-08936, B-09163, B-09469, B-09600, B-09789, B-09833, B-09971, B-10003, B-10681, B-11055, B-11131, B-11191, B-11233, B-11238, B-11251, B-12308, B-12503, B-12581, B-12797, B-14394, B-14566, B-15092, B-15532, B-15543, B-15572, B-15616, B-15692, B-17338, B-18111, B-18296, B-19034, B-19373, B-19475, B-19541, B-19560, B-19670, B-19672, B-19874, B-19972, B-20485, B-20539, B-21643, B-21720, B-22012, B-22057, B-22127, B-22279, B-22661, B-22702, B-23374, B-23376, B-23526, B-23544, B-24253, B-24269, B-24270, B-24516, B-24554, B-24565, B-24613, B-24675, B-24756, B-25079, B-25088, B-25127, B-25139, B-25184, B-25186, B-25269, B-25323, B-25503, B-25517, B-25602, B-25677, B-25743, B-25973, B-26084, B-26155, B-26220, C-04040, C-07721, C-26139, F-04939, F-08943, F-09064, F-09769, F-09967, F-10422, F-10429, F-11163, F-14851, F-16376, F-16883, F-22587, G-06826, I-04622, I-11286, J-08867, N-13587, N-22794

TEMPERATURE (ATMOSPHERIC) A-00691, A-10424, A-22159, B-24001, C-23350, D-05010, D-09591, D-11525, E-00023, E-02410, E-04033, E-04034, E-06373, E-08400, E-10053, E-10220, E-10229, E-10421, E-15178, E-17734, E-20924, E-21122, E-23723, E-24109, F-01379, G-16837, L-02011, L-03277, L-12461, N-04212

TEMPERATURE GRADIENT A-00691, A-01510, D-08858, E-04033, E-04034, E-04035, E-10229, E-16629

TEMPERATURE SENSING INSTRUMENTS A-05067, B-08870, B-09469, F-10429

TENNESSEE A-01489, A-16887, B-02192, B-04200, B-06636, B-08863, C-01856, C-07516, D-04116, E-00023, E-04033, E-04034, E-04035, E-16285, F-00530, L-11185, L-11781, N-03344

TENSILE STRENGTH B-08923, B-08937, B-08939, B-08940, B-08942

TESTING FACILITIES A-10183, A-10424, B-01245, B-06307, B-07674, B-10165, B-14566, B-16282, C-07787, C-11842, C-13477, C-22511, E-11624, F-00530, F-09769, L-01265, L-05105

TETRAETHYL LEAD D-05260

TEXAS A-01489, A-16073, C-07516, C-16875, L-08062, M-01221

TEXTILE MANUFACTURING A-09686, A-17688, B-08155, B-08352, B-11910, D-05260, L-24033

TEXTILES A-17688, B-07515, B-08155, B-09788, B-11910, B-24290, I-07553

THERMAL RADIATION A-21916, A-23619, A-25975, B-09833, F-11257

THERMOCOUPLES A-05067, B-08870, B-09469, F-10429

THERMODYNAMICS A-05011, A-10183, A-19444, A-25108, B-00544, B-03337, B-03581, B-13636, B-13817, B-15284, B-24001, B-25416, B-25529, B-26084, C-26139, F-09967, F-13601, F-17594, I-04622, J-07643

THIN-LAYER CHROMATOGRAPHY A-23884

THIOPHENE B-26211

THRESHOLDS A-25914, B-06999, E-24486, I-20820, L-11266

THUNDERSTORMS A-10754, E-10608

TIN B-09789, D-09591

TIN COMPOUNDS A-05067, A-06351, D-05551, D-09591

TIP BURN H-01014, H-01398, H-05420

TIRES A-10424

TISSUES F-00530, G-06806, G-07138

TITANIUM D-07951, D-09591, F-14512, N-07431

TITANIUM COMPOUNDS A-05067, A-06351, A-09831, B-19876, D-05551, D-07951, D-09591, N-04432, N-07431

TOBACCO B-09788, H-02299, H-05420

TOKYO A-13293, B-25088, D-07393, N-13591

TOLUENES B-02813, B-08352

TOMATOES H-02299, H-05420

TOPOGRAPHIC INTERACTIONS A-02765, A-10284, A-16073, B-01796, B-09699, B-11910, B-22884, B-24826, C-01856, C-05216, C-11340, C-23350, D-02818, D-02953, D-05010, D-10723, D-23356, E-01259, E-02410, E-03251, E-07428, E-07843, E-10608, E-10751, E-16629, E-20042, E-21099, E-23723, E-24486, I-07553, L-01890

TOXIC TOLERANCES F-00530, G-04136, H-01398

TOXICITY A-17688, A-21999, A-25418, G-08230, G-21276, I-20820

TRACE ANALYSIS A-02631, A-05067, A-07570, A-21383, C-07941, C-16149, E-10010, F-17592

TRACERS C-16149, C-18012, C-23377, C-26139, D-09984, E-10010, E-21073, E-21099, E-23409, E-26141, L-12461

TRACHEA F-00530, G-18109

TRADE ASSOCIATIONS J-00253

TRAINS A-07642, A-07645, A-08392, A-10424, A-25549, B-00975, L-00311, M-01220, N-00164, N-07845

TRANSMISSOMETERS A-19084, B-07359, C-03546, C-09624, C-19047

TRANSPORT A-23170, C-09624, D-25476, E-02410, E-10219, E-11980, E-16285, E-19737, E-25229, J-07643

TRANSPORTATION A-00972, A-01842, A-02290, A-03867, A-04287, A-04652, A-04778, A-07642, A-07644, A-07645, A-07647, A-07793, A-08392, A-08393, A-09169, A-09353, A-09686, A-09737, A-10183, A-10424, A-10442, A-10754, A-11619, A-11981, A-11982, A-12541, A-13954, A-14980, A-14997, A-15620, A-16073, A-16239, A-16722, A-16855, A-17052, A-17464, A-17483, A-17910, A-18052, A-19038, A-19434, A-19511, A-20736, A-20863, A-21204, A-21221, A-23954, A-24039, A-24955, A-25256, A-25259, A-25418, A-25549, A-26299, B-00975, B-02424, B-02442, B-04506, B-04516, B-06636, B-08080, B-08352, B-08584, B-08713, B-08870, B-09905,

B-09996, B-10493, B-10680, B-10770, B-12672, B-14394, B-15544, B-18110, B-18167, B-19261, B-20779, B-21819, B-24954, B-25139, B-25427, B-25529, B-26237, C-00886, C-09624, C-15479, C-16875, C-18012, C-21663, C-22882, C-23350, C-24412, D-00858, D-01790, D-02818, D-03431, D-04116, D-05260, D-05428, D-07393, D-09591, D-12496, E-00023, E-10421, E-11065, E-23723, E-24439, E-25075, F-00105, F-00530, F-11257, F-14686, G-11828, G-16192, H-02299, H-07786, J-00166, J-01546, J-13613, J-16174, L-00206, L-00311, L-01265, L-01399, L-01585, L-01890, L-02011, L-03359, L-03452, L-05499, L-06188, L-06686, L-07550, L-07950, L-08062, L-09073, L-12031, L-17472, L-24033, L-24214, L-26157, M-00336, M-01220, M-25143, N-00164, N-01063, N-04212, N-05194, N-07845, N-17819, N-21287, N-21289, N-23125
TRAPPING E-15483, E-17595
TREATED FABRICS B-04508, B-05163, B-07075, B-07515, B-09788
TREATMENT AND AIDS G-07039, G-07138, G-14530
TREES F-00530, H-01014, H-01398, H-01589, H-05420, H-07786
TRIPHENYLENES A-13494
TRUCKS A-08393, B-00975, C-00886, D-05428, M-00336, M-01220, N-00164
TUBERCULOSIS D-22591, G-14530, G-23670
TUNNELS B-01712
TURBIDIMETRY B-10165, C-04759, D-06755
TURBULENCE (ATMOSPHERIC) A-01510, A-24005, B-10704, B-23974, C-04040, C-05216, C-16364, C-22511, D-06777, D-09591, D-10723, E-01261, E-01934, E-05702, E-06775, E-06827, E-07843, E-08400, E-10220, E-10368, E-11065, E-11980, E-12353, E-16629, E-16803, E-17595, E-24243, E-26141, E-26267, F-00530, F-11722, L-11266, N-04212
TVA A-07800, B-08863, B-13674, B-14159, B-24142, B-25038, E-06823, E-09417, E-10421, E-25815, L-10503
TYNDALLOMETER C-04759, D-06755

U

ULTRAVIOLET SPECTROMETRY A-05067, A-23884, B-24837, C-22342, D-22812
UNDERFIRE AIR A-00532, B-16502
UNITED STATES A-01489, A-01816, A-03340, A-06351, A-07759, A-08388, A-10424, A-10754, A-11739, A-13479, A-14478, A-16489, A-16492, A-26299, B-00567, B-00568, B-06999, B-14087, B-16872, B-19480, B-24707, B-25602, D-05551, D-12496, E-23163, F-00530, H-02293, H-02299, H-07786, J-16506, L-00162, L-00206, L-00311, L-01654, L-06735, L-09474, L-17006, M-01221, N-06133, N-13591
URANIUM COMPOUNDS A-06351, A-06978, A-07800, A-08388, A-10442, A-16887, A-17052, A-18276, A-20863, A-23170, A-23239, A-25259, A-25914, B-04755, B-08917, B-11996, B-19876, F-13400, L-10503, N-07431, N-13513
URBAN AREAS A-07570, A-07647, A-08393, A-09737, A-10754, A-12285, A-16073, A-17199, A-17688, A-21383, A-24500, A-25418, A-26299, B-02149, B-09666, B-11910, B-20550, B-23757, B-24681, B-25187, B-25298, C-00886, C-01856, C-15348, C-16875, C-20224, D-01790, D-02057, D-03432, D-03514, D-05260, D-05428, D-05551, D-06824, D-07141, D-07393, D-07951, D-09591, D-11525, D-12496, D-13176, D-22591, D-22812, D-23326, E-06775, E-06827, E-07580, E-10368, E-11514, E-17725, E-19737, E-20068, E-21099, E-23723, E-25075, E-25229, G-06826, G-07138, G-08232, G-16192, G-18109, G-21276, G-23151, H-19620, J-21241, L-00162, L-01399, L-01585, L-01654, L-01890, L-05105, L-05499, L-07550, L-07950, L-08062, L-08686, L-09474, L-11266, L-12461, L-18121, L-24214, L-25688, L-26157, M-00336, N-21289, N-23125
URINALYSIS A-01842, A-02765, B-00140, B-00975, D-03432, F-00530, H-00316, H-01014, H-01398, H-01589, H-02293, H-02299, J-00166, L-00162, L-00311, L-02960, L-03359, L-03452, N-00164
USSR A-02549, A-04287, A-07570, A-08388, A-09103, A-13261, A-13330, A-17017, B-04634, B-06307, B-06999, B-08146, B-08155, B-08470, B-10165, B-10264, B-10591, B-11910, B-13817, B-13983, B-14057, B-15244, B-15665, B-15913, B-15946, B-19619, B-19629, B-22883, B-22986, B-25217, C-05216, C-08123, C-22982, D-02953, D-05260, D-07141, D-10723, D-22591, E-06775, E-07580, E-10219, E-10220, E-10229, E-10368, E-11370, E-16467, E-16687, E-17612, E-20042, E-20163, E-20924, F-11722, F-14390, G-07138, G-11437, G-12289, G-16192, H-19620, L-09474, L-10166, L-11266
UTAH A-01489, C-07516, L-11185, L-11781, M-01220, M-01221

V

VALLEYS B-00975, B-18045, C-23350, D-03514, E-01259, E-07428, E-24486, F-00530, I-07553, L-03277
VANADIUM B-03581, B-15251, D-05551, D-07951, D-09591, N-07431
VANADIUM COMPOUNDS A-05067, A-06351, A-09831, A-21999, B-02407, B-03337, B-03974, B-05454, B-08080, B-08346, B-08347, B-09191, B-09833, B-10692, B-11996, B-14087, B-14394, B-14566, B-19876, B-23880, B-25744, D-05551, D-07951, D-09591
VAPOR PRESSURE A-16788, B-08085, B-09833, B-12503, E-24109, F-16883
VAPOR RECOVERY SYSTEMS B-02778, B-16968, B-20779, B-25184, C-21663, F-13487, J-01546
VAPORS A-08390, A-09165, A-16887, A-18052, A-22159, B-01493, B-04755, B-05162, B-05338, B-08352, B-08584, B-09833, B-12672, B-14194, B-15560, B-17531, B-19373, B-23027, B-23526, B-24001, B-26220
VEGETABLES B-08938, H-00316, H-02299, H-05420, H-06967, H-20982
VEHICLES A-00972, A-07642, A-07645, A-08392, A-08393, A-09353, A-09686, A-09737, A-10183, A-10424, A-10754, A-14997, A-15620, A-17464, A-18052, A-19434, A-24039, A-25259, A-25418, A-25549, A-26299, B-00975, B-04506, B-04516, B-08352, B-08584, B-10493, B-18110, B-21819, B-25427, C-00886, C-21663, D-00858, D-03431, D-05260, D-05428, D-07393, D-09591, D-12496, E-23723, E-24439, E-25075, F-00105, G-16192, H-02299, H-07786, J-01546, J-16174, L-00206, L-00311, L-01265, L-01585, L-01890, L-02011, L-03359, L-05499, L-06188, L-07550, L-08062, L-09073, L-17472, L-24033, L-24214, M-00336, M-01220, N-00164, N-01063, N-04212, N-07845, N-21287, N-21289, N-23125
VENTILATION A-22875, B-01712, B-06307, B-08352, B-10399, B-18296
VENTURI SCRUBBERS A-03587, A-13410, A-15620, B-01493, B-06999, B-07385, B-07416, B-07931, B-08378, B-15665, B-16681, B-16720, B-16731, B-16872, B-18154, B-18161, B-20392, B-21720, B-22291, B-23955, B-24985, D-05260, J-01546, J-21241
VIRGINIA A-01489, A-17418, C-07516, L-11185, L-11781
VISIBILITY A-16788, A-25213, B-00975, B-09833, C-03546, D-03431, D-05428, E-16803, E-21736, F-00530, G-01865, G-11828, L-00206, L-09445
VISIBLE RADIATION C-09624, D-06777
VOLATILITY A-02631, B-23221
VOLCANOES A-10754, A-25213
VOLTAGE A-07644, A-07793, A-09165, A-10183, B-01615, B-05868, B-06062, B-08863, B-09789, B-10704, B-14473, B-15532, B-20485, B-22671, B-23955, B-25207, F-04939, F-09769, F-16589, F-24272, L-06686

W

WASHINGTON (STATE) A-01489, B-02813, C-07516, L-08062, M-01220
WASHINGTON D C B-22806, L-06188
WASHOUT E-05702, E-10608, E-25212
WATER A-10740, A-22159, A-24916, B-02971, B-03974, B-04755, B-08574, B-08919, B-08936, B-08939, B-08940, B-09191, B-09833, B-09904, B-09971, B-10165, B-11131, B-15962, B-16496, B-19373, B-20779, B-22702, B-23376, B-23447, B-23526, B-24001, B-24643, B-24785, B-25079, B-25186, B-25320, C-22391, C-23121, E-10153, F-04939, F-08943, F-10429, F-14390
WATER POLLUTION A-11982, A-11988, A-17184, A-19511, A-21191, A-21204, A-21383, A-23619, A-23652, A-24535, B-01245, B-09905, B-15572, B-15933, B-16815, B-18063, B-25038, B-25170, D-07393, J-01546, L-24214, M-08072
WEATHER FORECASTING B-24001, D-11525
WEATHER MODIFICATION E-15178, L-03359, N-17819
WEST AND GAEKE METHOD C-17468, E-11624, E-21099, I-20820, L-01890, L-03277, L-08686
WEST VIRGINIA A-01489, A-02765, B-01866, B-06297, B-06636, B-16815, B-18045, C-07516, D-03514, J-01308, L-01590, L-09443, L-11185, L-11781

WET CYCLONES A-03587, A-26233, B-00135, B-00140, B-04791, B-05163, B-06999, B-07385, B-07416, B-08146, B-08155, B-08342, B-08378, B-09523, B-14137, B-16720, B-19471, B-20097, B-23682, B-26063, B-26237, J-01546
WETTING A-13494, B-07416
WHEAT B-08938
WIND ROSE A-16073, A-16887, E-05702, E-08400, L-09445
WINDS A-00691, A-01510, A-01842, A-10678, A-16073, A-16887, A-22159, A-24500, B-00687, B-00975, B-01796, B-04200, B-06835, B-20550, B-22051, B-22500, B-22884, B-23974, B-25298, C-01856, C-02668, C-04040, C-11340, C-15925, C-16364, C-22511, C-23350, D-02046, D-02818, D-02979, D-03431, D-03514, D-05010, D-06777, D-08858, D-09591, D-09984, D-10723, D-11525, D-23356, E-00023, E-00846, E-01259, E-01260, E-01261, E-02410, E-03251, E-03557, E-04033, E-04034, E-04035, E-05357, E-05702, E-06373, E-06775, E-07428, E-07843, E-08400, E-10010, E-10053, E-10219, E-10220, E-10229, E-10421, E-10608, E-10751, E-11065, E-11370, E-11514, E-11980, E-13965, E-14271, E-15483, E-16687, E-16803, E-17580, E-17595, E-17734, E-19503, E-19737, E-20924, E-21986, E-22313, E-23723, E-24341, E-24391, E-24407, E-24486, E-25212, E-25229, E-25815, F-01379, F-11257, L-01265, L-01654, L-01890, L-03277, L-08686, L-09445, L-11266, L-11383, L-25688, L-26157, N-04212
WISCONSIN A-01842, B-03879, L-00973, L-08062
WOOD A-25545, B-08085, B-09788, B-10680, B-24697, C-23096, J-00978, K-06696
WOOLS B-09788, I-07553
WYOMING A-01489, C-07516, L-11185, L-11781, M-01220, M-01221

X

X-RAYS A-02631, A-13494, C-07941

Y

YOKOHAMA D-07393, F-00530

Z

ZINC A-09686, B-00107, B-09789, B-11906, B-21324, D-05551, D-09591
ZINC COMPOUNDS A-05067, A-06351, B-03581, B-08347, B-09788, B-09833, D-05551, D-09591, H-06967, L-00311, L-17472
ZIRCONIUM A-10442, F-14512